THE

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ELECTRICAL REVIEW.

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	Page
Standards of Rating	721
The Distribution of Electricity	722
Indian Public Tenders	722
Transportation and Trade	723
Great Britain's Tramways	723
The Engineering Joint Council	723
The Clyde Valley 33,000-volt Interconnector Cable (*illus.*)	724
The Depreciation of Plant and Machinery, by Herbert G. Clayton	726
The Financial Aspect of Small Power Stations, by E. J. Hawkins (*illus.*)	727
Legal	729
Correspondence—	
Cleanliness in Wiring	731
Motor-car Wiring	731
Power Factor	731
Costing	731
Government and Inter-Imperial Trade	732
Can the "Maximum" Price be Exceeded?	732
Business Notes	732
Electricity Supply at Leeds (*illus.*)	739
Tramways and Light Railways in 1921-22	743
Notes	745
City Notes	748
Stocks and Shares	749
Swiss Problems and Progress	751
The "Glow-Clad" Wiring System for Mines (*illus.*)	752
A New House-service Meter (*illus.*)	753
Electromagnetic Forces, by Carl Hering	754
High-speed Alternators	755
Electricity in Iron and Steel Works, by C. A. Ablett	756
Research Laboratories at Sheffield University	757
New Electrical Devices, Fittings, and Plant (*illus.*)	758
Parliamentary Notes	759
New Patents	759
Published Specifications	760
Contractors' Column	Advertisement page xxviii

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STANDARDS OF RATING.

IN view of the excellent work that has been done by the British Engineering Standards Association, and the enormous economies that have resulted from the adoption of the specifications which it has issued, to the great benefit of the British engineering industries, it was unfortunate that its Standardisation Rules for Electrical Machinery (Publication No. 72-1917) should have proved to be a dead letter. For this mishap the Association cannot be held responsible; the new system of rating, on the basis of a limiting temperature without any reference to permissible overload, which was embodied in that publication was adopted in accordance with a decision arrived at by international agreement, with a view to securing a single universal standard which would place all nations on the same footing and ensure that their competitive products should be referred to a common basis of comparison. The negotiations and investigations which took place were by no means unfruitful, for they resulted in agreement regarding the limiting maximum temperatures at which electrical machinery could be safely operated without unduly shortening its life; and though those limits may be subject to revision from time to time, there is no reason to fear that the principle of common standards which has been sanctioned by international agreement will be departed from.

However, the method of rating on which the specification of 1917 was based proved to be unacceptable to British manufacturers and purchasers of electrical machines, and in compliance with their urgent representations the new B.E.S.A. publication No. 168/1923 was issued two months ago, in which the customary British practice of rating on the basis of full load and overload was embodied. This proceeding did not constitute a repudiation of the international agreement, for a meeting of the Advisory Committee on Rating of the International Electrotechnical Commission was held at Geneva in November, 1922, at which sanction was given to the proposal for the adoption of the system for home use; moreover, the I.E.C. is considering the question of adopting the overload rating for industrial machines as an additional international standard. The rules provide that in no circumstances shall the maximum temperatures exceed those laid down by the I.E.C., and that the international rating shall be indicated on the rating plate in addition to the British standard rating.

An admirable commentary on the new B.E.S.A. specification was communicated to the *Electrical World* of April 7th, 1923, by Mr. Philip Torchio, chief electrical engineer of the New York Edison Company, who gave excellent reasons for the use of the double rating. Unlike, say, an oil engine, which has a fixed maximum output, an electrical dynamo or motor will carry almost any load that it is called upon to bear—for a time; this is an immense advantage in emergency, but is liable to be abused. Mr. Torchio points out that if the machines are normally rated up to the hilt, the user must himself "derate" them in order to provide for a safe margin which can be drawn upon in time of need; obviously it is far better that the margin should be fixed by the manufacturer, and that the user should be furnished with precise information as to the maker's views on the capabilities of his machine to meet both normal and abnormal conditions of service. This was in fact universal practice before the war, but, as Mr. Torchio remarks, the permissible percentages and

duration of overload had never been standardised, so that fair comparisons could not be made between rival machines, and hence the proposal to adopt one uniform rating with a fixed rise of temperature "suddenly met with the favour of many."

Mr. Torchio, however, whilst cordially approving of the new British specification, has a new solution to the problem to offer, which appears to be worthy of serious attention, as it purports to combine the advantages of both systems of rating. He proposes that for acceptance tests the overload tests alone shall be applied, and that the ultimate temperature to be reached by the machine *on overload* shall be prescribed, "regardless of whether it shall require one hour, or two or more, with the overload kept constant." He states that within a period of two hours on overload "rotating machines in general reach within two or three degrees of the ultimate temperature even in the case of the largest size units." In support of this proposition he refers to the advanced knowledge now available as to the relation between temperature and life of fibrous insulation, which can withstand safely for short periods a temperature as high as 160 deg. C., and continuously a temperature of 120 deg. C. for over two years without being destroyed. By his method of rating, machines can be rated "for normal load with a rise of temperature that will produce the longest and most economical life, and for overloads with a rise that will not endanger the safe operation of the machine when carrying the occasional heavier load demands of the service as the demands arise." The designer will seek to obtain the highest efficiency and power factor possible at normal load, and will be able to give increased overload capacity at the same cost with a reduced efficiency on overload.

At first sight it may appear that Mr. Torchio's suggestion practically amounts to a return to the I.E.C. single rating, with the substitution of the term "overload" for "normal load" at the maximum temperature; but this is not the case. It would be more correct, we believe, to say that the scheme is equivalent in effect to retaining that rating, with the present maximum temperature, for normal continuous load, and extending the permissible temperature rise by some 20 deg. C.—but specifying only the ultimate temperature attained with a definitely stated percentage of overload. There have been indications of late that British manufacturers would not hesitate to run their machines continuously at temperatures materially higher than those at present ruling; and there is no doubt that occasional short runs at much higher temperatures can be permitted without risk. As knowledge advances practice should also progress, and whilst the new B.E.S.A. specification will serve immediate needs, we trust that such proposals as that of Mr. Philip Torchio, whose wide experience commands respect, will be fully debated with a view to attaining the most satisfactory solution of the rating problem.

The Distribution of Electricity.

WITH the certainty in view that at no distant date an enormous domestic load will be added to the existing and still increasing power load in our large towns, electricity supply undertakers have before them a problem that will not easily be solved—namely, how to distribute energy on the large scale. Even now the question has become acute in some areas—it will be noted in this issue that at Leeds the number of feeders is well over 500. A few years ago the subject was raised by Mr. C. A. Gillin at an I.M.E.A. Convention, and at the time we expressed the view that high-pressure a.c. distribution to points as near the actual load as possible, with transformers in kiosks or street boxes, afforded the most practical solution to the problem. To continue distribution with direct current over large areas from a central generating station will become impracticable on account of the excessive cost of low-pressure mains. An alternative, or compromise, in the case of industrial areas where a change from d.c. to a.c. would be too costly is foreshadowed by the new developments in rectifiers which are in progress. Already the mercury-vapour rectifier is made in fairly large sizes, both with steel and with glass containers, and it is more than possible that rectifiers of the thermionic type, which are at present of small output, will in due course be developed to deal with large outputs; such apparatus, being free from rotating parts, are well adapted for automatic operation and control, and in this connection the methods adopted by the Birmingham Corporation, under the direction of the city electrical engineer, Mr. R. A. Chattock, which we described in our last issue, are worthy of close attention. In Manchester also, under Mr. S. A. Pearce, interesting developments are under way.

But even when the low-pressure distribution problem is solved, there will remain another of scarcely less difficulty—that of high-pressure distribution. It is interesting to note that in the United States a method is being tried of which as yet few examples are to be found in this country—namely, that of running extra-high-pressure ring mains overhead round the outskirts of the town to be served. This system has been adopted at Pittsburgh, where a steel tower line with two circuits working at 66,000 volts has been erected round the city, feeding sub-stations at intervals. At Detroit, also, a power line runs halfway round the city, at 120,000 volts. Many difficulties, however, have been met with, not least of which is that of procuring wayleaves in suburban districts. In this country overhead lines would not be tolerated so close to the densely-populated areas; the mains will have to be put underground.

The ring-main system has the great advantage of providing a supply at any point on it from both directions, but when the district served is of large area and the whole supply is generated at one point, the distance of transmission becomes excessive, and numerous operating and controlling difficulties arise.

Indian Public Tenders.

POWDER and jam for the British manufacturer are contained in the report of the Indian Railway Industries Committee, a copy of which has been received at the Department of Overseas Trade. We will reverse the usual order and first take the jam. It is in the form of whole-hearted commendation of United Kingdom industrialists, who, says the report, are well-known to be fighting with backs to the wall in order to keep their works open and their men employed. For this purpose, it is added, they are quoting prices which in some cases at any rate are believed to be below the commercial cost of production. The case in point was a tender for 3,000 railway wagons of different types, but there is no doubt that many firms have adopted a similar course in order either to retain an old and valued customer on their books or to gain a footing in a new direction where future prospective business appeared to warrant an initial sacrifice. Though sales managers, and indeed shareholders, are thoroughly aware of the difficulty of competing against low exchange countries, and at the same time paying dividends, it is gratifying to hear the Indian Committee's appreciation, particularly in view of the criticism so often levelled against the British manufacturer that he is unaccommodating and will make no concessions in his prices. The contract for the wagons in question was obtained by a British firm in the face of 43 other tenders from eight countries in all, the lowest satisfactory Indian offer being 50 per cent. higher than the lowest English tender. Now we come to the powder. The Committee was appointed to consider what steps should be taken to ensure that as large an amount as possible of the funds to be spent on rehabilitating the railways during the next five years should be spent in India. It makes a general recommendation that if the principle of guaranteeing orders to Indian industries be accepted as a legitimate means of encouraging industries in India, the guaranteed price should, as a rule, be fixed

in accordance with existing practice, *viz.*, the c.i.f. price of the imported article of similar quality, *plus* import duty. The Committee proceeds to make a special recommendation regarding products which involve elaborate fabrication and large bodies of skilled labour. It had in mind the locomotives on which the Indian makers were so fiercely undercut, but electrical apparatus also would doubtless come into question. If such specialised industries are to be developed—or rather kept alive—in India, the Committee state that they must receive some form of protection or Government assistance. We do not suggest that the British engineering industry will immediately be confronted with a very high tariff wall in India, but there is cause to fear that the party which favours an extremely protective policy is gaining adherents. The revisions which the Committee proceeds to recommend in the rules for the purchase of public stores are obviously designed to discourage buying abroad unless there is a definite threat to economy or efficiency by turning to Indian industry.

Transportation and Trade.

From the immediate standpoint of the general public the subject of railway and other traffic charges is a personal one bearing on daily travel, because it affects journeys to and from the place of employment or travels in the course of business, or journeys while on pleasure or recreation bent. But it affects everybody in connections which are quite as important as an economy of a few shillings a week. Rates reductions and classification revisions may affect many of the commodities used in daily life—only in a small way for the individual article it is true, but in a considerable way taking supplies all round and in the bulk. Even then, however, the limit of the public interest in the matter is not reached. These personal or household affairs, while they are the direct interest of the millions of consumers of everything, have an effect on industry because they, in however small a degree, advantage those who are employed in industry. But industry as industry is also directly concerned in securing reductions and reasonable classification revisions to assist trade revival. Consequently the attention that has been devoted to the matter by trade and other associations, &c., is more than justified. Reference was made to the matter at the annual meeting of the London Chamber of Commerce last week. The president (Lord Kylsant) said that the substantial "cuts" in railway rates which had lately been announced were a "welcome instalment," and should stimulate trade. Some of our industrial leaders hold that among the few remaining directions in which they can reasonably look for means of reducing production costs that of railway rates is one of the chief. This being so, we may depend upon it that if railway authorities are unable to assist trade development to the full extent of their responsibility, there will inevitably be an accelerated movement for utilising other means of transportation. If railway wages are to be maintained against the interests of the industries of the nation they will be maintained to the disadvantage of the whole of our people, even against the interests of the railway wage-earners themselves. An aspect of the subject which we cannot afford to ignore is the cost of transportation in its bearing upon export trade. Continental facilities on the railways for encouraging export trade were a theme well to the fore in electrical discussions years ago, and every British trade needs all the help that it can legitimately be afforded in times when we ought to do everything possible to create employment. Lord Kylsant said it was certain that when a real revival of our overseas trade took place, the question of the various modes of transportation would assume greater and special importance. The speaker was able to refer to the better relations that had recently been developed between the commercial community and the railway and shipping companies. This is very satisfactory, of course, and it is desirable that it should continue. Railway and road transport and overseas conveyance are three parts of the one problem; they all bear especially on Colonial and foreign trade, and therefore form one of the leading items calling for unceasing attention from that section of electrical trade organisation which exists to secure the best conditions for manufacturers and traders.

Great Britain's Tramways.

The period covered by the report of the Ministry of Transport upon the tramways, light railways, and railless trolley systems of Great Britain—namely, 1921-22—cannot be said to have been normal, and therefore any comparison with the last pre-war year may be of interest, but of little real value in forming an idea of what has actually taken place in the industry.

Thus, although instead of contributing to the rates, the tramways have fallen into the position of being partially dependent upon this form of "subsidy" (taking them as a whole), looked at from another angle business would appear to have improved. In spite of the fact that the car-mileage run decreased by 2.02 per cent. as compared with 1913-14, the number of passengers carried increased by 28.90 per cent. This is a sign of the times reflecting the difficulties in the way of extension and the resultant overcrowding of our transport systems.

The actual gross profit has increased, but the tramway industry, in common with all others, has been heavily burdened with taxes, and the effect of this has been severely felt. In one direction at least economy was effected during the year; the energy consumption per car-mile was reduced by about 1.6 per cent. as compared with the previous year.

Upon the whole, we think that the industry will survive the many obituary notices which make their appearance from time to time; improvement is beginning to be apparent, and the gradual return to normal trade conditions, by which the tramways are directly affected, will lead to a resumption of that progress which was checked by the war.

The Engineering Joint Council.

The issue of the constitution and by-laws of the Engineering Joint Council marks an important stage in the development of an organisation which is destined, we believe, to exercise powerful influence on the future of engineering in this country. It is defined as "an advisory body without executive powers"; founded by the Institutions of Civil, Mechanical, and Electrical Engineers and Naval Architects, it has framed rules for the admission of representatives of other engineering institutions of approved standing, and for the consideration of matters referred to it by other bodies whose membership is not necessarily confined to engineers; in due course, therefore, we may expect the Council to become fully representative of the whole of the profession, and to be in a position to act on its behalf whenever occasion arises for the profession to speak with one authoritative voice.

Hitherto the engineering interests have not secured that share in the councils of the nation to which they are entitled in virtue of the training and experience of their membership and the importance of the industries with which they are associated—industries upon which the stability and prosperity of the whole nation as a manufacturing and exporting community and the safety of the country in time of war are ultimately dependent. We noted with gratification the election of several engineers to Parliament in November last, and should be glad to see their number greatly increased, so that questions affecting the interests of the engineering industries might be placed before the House of Commons in the proper light; but there is a still larger scope for action in other quarters which can be efficiently dealt with by the Engineering Council, and we earnestly hope that it will miss no opportunity of taking part in public affairs. Passive watchfulness is of little service; we look to the Council for initiative and enterprise, for aggression where necessary, and, above all, for leadership.

D

THE CLYDE VALLEY 33,000-VOLT INTERCONNECTOR CABLE.

Biased Differential Protection.

One of the largest 33,000-volt underground cables at present installed in the British Isles is that in the Clyde Valley, which is used to interconnect the Yoker and Clyde Mill electricity generating stations.

It was constructed at the Pirelli-General Cable Works, Ltd. (one of the associated factories of the General Electric Co., Ltd.), Southampton, and is of the three-core type, each core being of 0.2 sq. in. cross-sectional area, having round paper-insulated conductors, the three cores being laid up and made circular with impregnated-paper filling, and covered by a further belt of impregnated paper, lead sheathed, compounded jute served, double steel-tape armoured and compounded jute served overall. The cable is built for a working voltage of 33,000 V, the centre point of the system being earthed, and has the following dimensions:—Thickness of insulation—copper to copper—0.512 in.; thickness of insulation—copper to lead—0.354 in.; thickness of lead sheath, 0.15 in.; thickness of each steel tape, .06 in.; overall diameter, 3.55 in.; weight per mile, 38.5 tons.

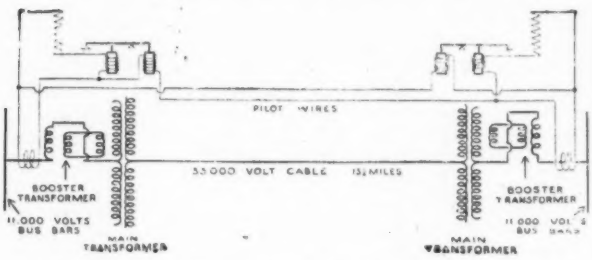

Fig. 1.—Connections of McColl Protective System.

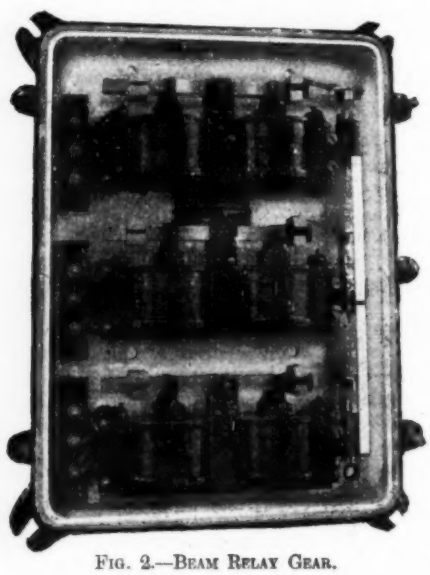

Fig. 2.—Beam Relay Gear.

The cable was manufactured in lengths of 200-220 yards, its total length being 15½ miles. The tests made in the works on each length during the lead-cased stage gave the following results:—

1. Insulation resistance measured at 400 volts, d.c. after 24 hours' immersion in water—250 megohms per mile average.

2. Inductive capacity measured between one core and the other two and earth at 400 volts d.c.—0.29 microfarads per mile average.

3. Conductor resistance checked after 24 hours in water.

4. Each drum of cable pressure-tested at 66,000 volts for ½ hour between cores and 40,000 volts for ½ hour between cores and lead.

5. Bending test (made on a percentage of the drums);

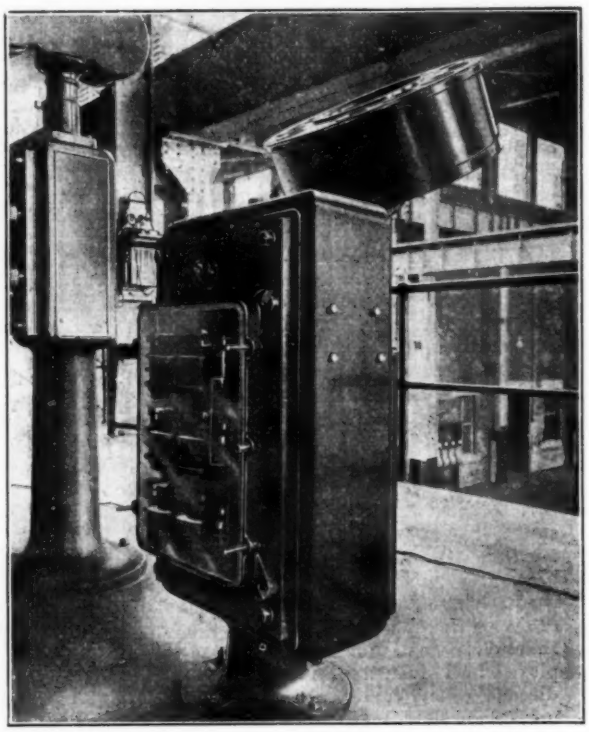

Fig. 3.—Beam Relays, Mounted.

a three-yard sample bent three times in each direction to a radius equal to ten times the diameter of the cable; no sample so tested broke down at less than 120,000 volts between cores or 80,000 volts between cores and lead.

6. A dielectric loss test was made at voltages up to 50 per cent. above working pressure in all cases.

When the cable had reached the finished stage, further tests were made as a check, and, in addition, samples of the cable were subjected to special pressure tests, as follows:—

Sample No. 1 was tested by applying and gradually raising the pressure between two cores until the testing

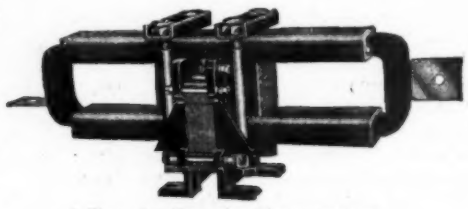

Fig. 4.—Current Transformer.

ends flashed over, the voltage at which this occurred being 192,000 volts between cores; a similar test was made between the cores and sheath up to a voltage of 120,000 V, but the cable was not broken down.

Sample No. 2.—To ascertain what would happen if the cable were run at a considerably higher voltage for a long period of time, a length was subjected to a three-phase pressure of 100,000 volts between cores for a period of six hours; at the end of this time, although

it had not broken down, the cable was dissected, and it was found that in some places the paper was very slightly carbonised, which, of course, was to be expected.

Sample No. 3 was subjected to a three-phase pressure of 60,000 volts between cores, which is nearly double the normal working pressure, for 24 hours continuously; at the end of this time the cable was opened,

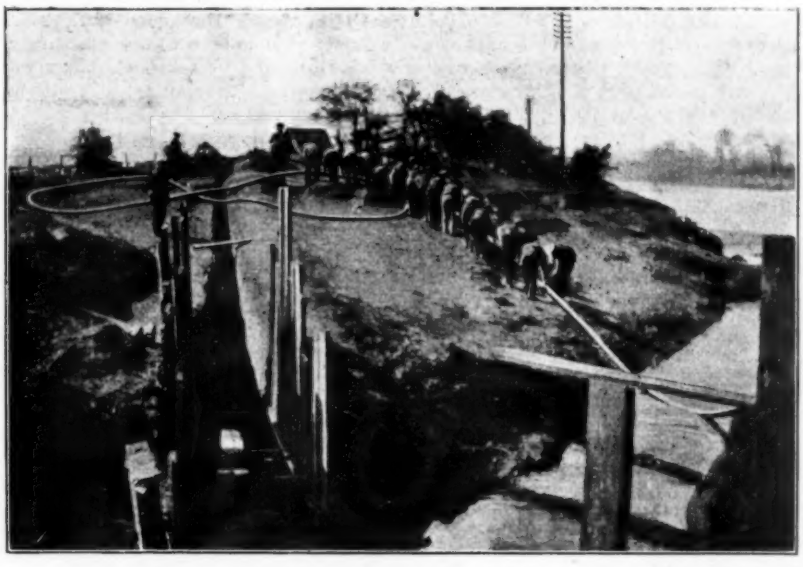

Fig. 5.—Handling the Cable on the Bank of the Clyde.

and it was found that absolutely no carbonising of paper, either in the insulation of the cores or in the fillings, had taken place.

The particular features to be observed from the test results are that the cable itself has an exceedingly high breakdown voltage and, further, that it will stand for a considerable time very great increases of pressure.

The G.E.C. biased differential (McColl) protective system is used for protecting this cable, the main feature of the system being the use of a relay having a definite bias,* the operation of which depends primarily upon an out-of-balance current being set up in the auxiliary relay circuit due to the fact that more current flows into a feeder than flows out of it when a leak occurs. The current is produced in the relay circuit by means of current transformers at opposite ends of the feeder, the secondaries of which are connected for circulating current and in series with the relays by means of pilot wires.

The Clyde Valley interconnector has an 18,000-kVA, 11,000/33,000-volt transformer bank at each end, as shown in fig. 1. Likewise a 1,500-kVA bank of booster transformers is placed at each end to compensate for drop in line and inductive drop in the main transformers at low power factors. The series transformers for the protective gear are connected in the 11,000-volt side at each end, and include within their protection the main transformer banks, booster banks, and cable. The main transformer banks are 11,000-volt delta and 33,000-volt star, the neutral point of the 33,000-volt side being earthed solid on one bank and through a spark gap on the other bank.

The protective apparatus presents some features of interest. The relays are of the beam type, with main and restraining coils, fig. 2; in fig. 3 they are shown in position on a pedestal on the switchboard gallery. The beam and coils are built up on the laminated-iron circuit which forms the basis of the apparatus, the beam being of aluminium on substantial pivots, and the coils are wound upon bobbins of solid black Bakelite. A particular feature is the entire avoidance of eddy-current losses, which often occasion trouble in metallic bobbins.

Moulded insulation is also used for the terminal blocks and for the trip contact supports; the latter are usually designed to take carbon contacts, this material being the only one available that is definitely free from sulphurous corrosion which produces an insulating film on metals. Silveroid, the most satisfactory metal from this point of view, is used for low tripping voltages. The fulcrum pins are displaced from the middle of the beam away from the restraining coil sufficiently to give the latter a 5 per cent. bias over the operating coil; further regulation of the bias may be obtained by duplicate resistances at one end of the feeder, *e.g.*, three for a three-phase circuit, which may be regulated to increase the bias of the relays by allowing a greater percentage of the transformer current to be diverted through the restraining coil.

The instrument transformers were made at the G.E.C. associated Chamberlain & Hookham works, and are of the tube type "T" (fig. 4). The primary winding consists of a few turns of copper strip passing through Bakelite tubes; the latter are of sufficient length to withstand a flash-over voltage greater than five times the normal working voltage, and are thus capable of dealing with surges and other transient phenomena. To resist the forces that tend to disrupt the primary winding under short-circuit conditions, the two long sides of the rectangular coil are supported by four steel bolts, the tubes being maintained in their

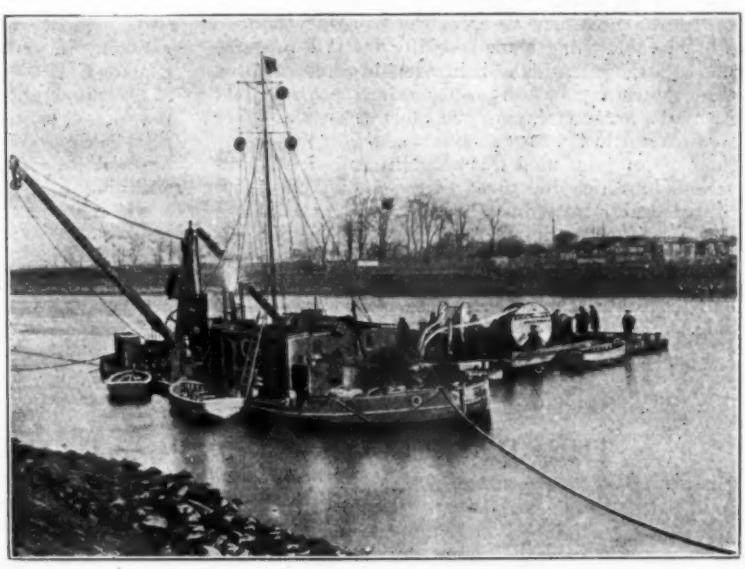

Fig. 6.—Laying the Cable Across the Clyde.

* Elec. Rev., October 27th, 1922; pp. 596-7.

correct positions by spacing pieces. The secondary winding consists of a former-wound coil impregnated with insulating varnish, after all moisture has been removed in a vacuum chamber. The core is built up of non-ageing silicon steel stampings and the joints are imbricated in order to reduce their magnetic reluctance. After assembly, the core is clamped between two brackets provided with feet for bolting the transformer on to its support.

The laying of the cable gave rise to several problems. Along part of this route it was carried alongside the bank of the River Clyde, and fig. 5 gives some idea of the work done in handling the cable and avoiding the various obstacles which were met with during the laying. It was necessary to cross the River Clyde, two lengths of cable being made specially for this purpose, which, with the exception of being double wire-armoured instead of steel-taped, were of standard construction. The actual process of laying the cable across the River Clyde is shown in fig. 6.

The type of joint used was of plain and simple construction, in which the three cores of the cable were separated and jointed in a horizontal plane as shown in fig. 7. After the joints were made, a lead box was put round them, and the concluding illustration (fig. 8) shows the lead box ready for the compound to be poured in and the containing cast-iron box placed in position outside.

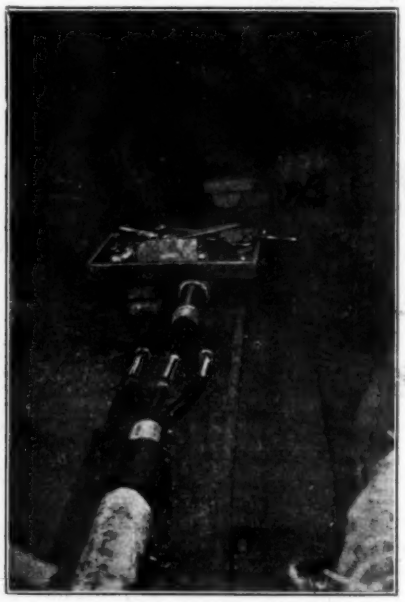

FIG. 7.—A 33,000-V CABLE JOINT.

FIG. 8.—COMPLETED JOINT.

Tests taken on demonstration joints at the works were as follows:—

1. Routine test at double working pressure, *i.e.*, 66,000 volts between cores and 40,000 volts between cores and earth.

2. Breakdown test—in this case, as before, the limiting voltage was that at which the testing ends flashed over, *i.e.*, between cores 176,000 volts, cores to earth 87,000 volts; the joint was not broken down.

3. A six-hour test at double working pressure was made with the joint heated to 80 deg. C., after which the pressure was raised and the joint broke down at 80,000 volts between conductors.

The specified tests after laying are 92,000 volts between cores and 56,000 volts to earth, made with d.c. as owing to the length of the main an a.c. test is impracticable.

The pilot cable used in connection with the relays of the McColl system contains three cores each of 7/20 S.W.G. copper wires insulated with impregnated paper, but not provided with any copper shield. Laid up with the relay cores are two pairs of 1/20 telephone conductors, each insulated with impregnated paper. The whole cable is made circular with impregnated paper filling, and served with an outer belt also of impregnated paper. The cable is then lead-sheathed, compounded jute served, double steel tape armoured, and compounded jute served overall.

THE DEPRECIATION OF PLANT AND MACHINERY.

By HERBERT G. CLAYTON.

In the course of running an engineering works, it will be found that, in addition to the customary "overhead" charges, there is a further expense arising, against which it is necessary to make adequate provision.

The expense referred to is known as "depreciation," and, owing to the fact that in many cases machinery can be used with little *apparent* wear, there is a tendency—especially in small engineering works—to overlook or ignore this important matter. On looking thoroughly into the matter of costs, however, it is obvious that as machinery installed is an asset to the firm, any diminution in its value is actually and substantially a direct financial loss in the same way as the payment of rent, lighting, postages, salaries, &c., and, finally, this loss should be treated in precisely the same manner; that is to say, written off against revenue.

In order, therefore, to meet this contingency in a correct manner, a depreciation account should be opened in the "nominal" ledger, and to this account should be *debited* periodically the amount considered necessary on the firm's machinery; similarly, the sum arrived at for depreciation purposes should be

credited to the machinery account in the ledger, thus writing off—or reducing—the purchase price, as, of course, the price paid will have been already debited to the last-mentioned account.

If machinery were not depreciated methodically, it will readily be seen that when new motors or apparatus became necessary for the continuance of the business, fresh capital would have to be found, and in many cases such a course might be extremely undesirable, and, indeed, impossible.

In dealing with the principles of depreciation, an important fact to bear in mind is the possibility of a particular machine's being superseded by a later and better model before it is actually worn out. This, however, can be guarded against to a great extent by an adequate sum being written off periodically. This point illustrates the importance of keeping a proper account for expenses of this nature. It is well to remark here that the term "depreciation" indicates a *permanent* decrease in the value of an asset, and covers more than mere wear and tear. Furthermore, it is not influenced by temporary market fluctuations.

The two methods generally adopted in dealing with depreciation are known as:—

(1) The fixed instalment method.
(2) The diminishing balance method.

In (1) an agreed proportion of the purchase price is written off at certain intervals, and in this way the asset is reduced gradually in the books of a firm to correspond with its actual value at date. Before a concrete example of depreciation is dealt with, other considerations arise, namely:—

(*a*) The original cost of the machinery.
(*b*) The probable duration or "life."
(*c*) The final or "scrap" value.

When these three points have been ascertained, the position becomes clearer and can be worked out on the following lines:—

If machinery were purchased for (say) £250, the period of its duration estimated at ten years, and the scrap value considered good for £25, it is obvious that £250, less £25, equals £225, which must be written off in the "life" of the asset—that is, ten years. This, of course, equals £22 10s. annually, and, therefore, is the sum which must be debited to the depreciation account and credited to the machinery account. It will be seen by this method that at the end of the estimated period the loss sustained by virtue of the worn condition of the asset will have been provided for, and only the residuary value of £25 will remain outstanding.

In (2) the diminishing balance system, a fixed rate percentage on the annual balance of the asset is written off. For example, if machinery were purchased for £250, and depreciated at 10 per cent. per annum, in ten years' time there would be a balance remaining of approximately £87 3s. 6d. Under this second method 10 per cent. would be deducted from £250 in the first year, leaving a balance to carry down of £225. In the second year, 10 per cent. of £225 would be deducted and the amount of £202 10s. carried down, and this process would be continued for the entire period. Therefore, it will be seen that the amount depreciated each succeeding year would be less and less, and this method is held to be justified for the following reason: When machinery is first purchased, the cost of repairs and renewals are light, and at this period depreciation is at its heaviest. Later on, however, as the machinery begins to wear, defects will develop and the cost of repairs commence, and at this stage the depreciation will become lighter and lighter. In the concluding years, when the amount for repairs and renewals will be at its heaviest figure, the sum being written off for depreciation will be very low.

The total of the depreciation account in the "nominal" ledger is eventually closed by transfer to the profit and loss account in the same manner as all other charges against revenue.

It is maintained by some cost accountants that the item of depreciation should be included in the usual costs accounts, but to arrive at an accurate percentage is rather a complex problem. In any case it is essential that finally it is really taken into account as an indirect cost on all work turned out.

The usual rates allowed for depreciation are as follows:—

Furniture and fixtures	5%
Switchgear	7½%
Machinery	7½%—10%
Rolling stock	10%—15%

It may be noted that depreciation of assets is not compulsory, and it is a matter for the decision of the proprietor himself, who must act in accordance with his own judgment. It is, however, felt that the foregoing remarks may be useful to any small engineer, who, although not fully commercially trained, is endeavouring to place his business on a sound financial basis by the adoption of a correct and cautious administrative policy.

THE FINANCIAL ASPECT OF SMALL POWER STATIONS.

By E. J. HAWKINS.

The financial success of small power stations involves a problem of no mean dimensions. The problem exists also in large supply companies, but its aspect is not so formidable as with smaller stations. The proportion of capital charges to revenue is not so high in large companies as in small ones, and much discretion in expenditure allocation is necessary to reduce production costs to achieve the largest difference possible between expenditure and revenue.

Land, building, and plant costs are the biggest factors in capital outlay, and it is in these the greatest inequality is found. For example, the outlay involved in these three items for a 200-kilowatt station might be approximately £9,000; for a 1,000-kilowatt station, £30,000; and for a 5,000-kilowatt station, £90,000, assuming the same type of installation and land values to be equal in all cases. This gives a cost per plant kilowatt of £45, £30, and £18 respectively, and shows a proportionately higher capital charge on the smaller station. This charge must be met from revenue before any money is available as dividends. To meet it successfully the cost of production must be cut to a minimum, and the earning capacity of the station maintained at a maximum; the load factor of the station must be high.

Cost of production may be divided under two headings—running expenses and administration expenses. The first includes fuel, oil, water, stores, repairs, and wages; the second, directors' fees, salaries, rates and taxes, insurance, and incidental expenses.

In the first, little economy is possible. The cost of running the plant varies in almost direct proportion to the load. Fuel, oil, and water consumption are dependent upon the station output, and the staff directly connected with the running of the plant must be maintained in proportion to the number of working hours.

Under the second heading, much may be done to minimise expenses. In all small stations directors' fees

should be merely nominal. The duties devolving upon them are small compared with those falling upon the directors of larger companies, and their interest is usually provided for by their share holding.

The question of salaried staff is an important one. Much money may be wasted if the company is overstaffed, but similarly, the economic working of the station may be considerably impaired if the staff is cut too fine. For a 200-kilowatt station a competent engineer to act as engineer and manager would be sufficient to supervise the working of the entire installation. Under him should be an outside engineer responsible for all matters relating to distribution and supply, and upon whom should devolve the duties of sales engineer. Two clerks, a junior, and a meter reader should be sufficient to cope with the general clerical services of the company. Two linesmen would be necessary to assist the outside engineer in the maintenance of the distribution system, casual labour being employed as required. With slight modifications to suit specific circumstances, such a staff should be capable of maintaining the installation.

The earning capacity of the station is governed by the load factor. The higher the load-factor the greater the earning capacity. The ideal station is one in which the load factor is 100 per cent., but it is not a practicable proposition. To achieve this the full rated output of the station must be delivered continuously day and night without variation. A 200-kilowatt station would have to deliver 200×8,760=1,752,000 kWh each year. Load factors obtained in practice vary between 10 per cent. for a purely lighting load to 40 per cent. for an all-power load.

If, then, the station is supplying current for lighting purposes only, it means that the plant will be idle a greater portion of the 24 hours. The number of kWh taken by consumers will be small, and the high cost in order that the total income may cover cost of production, provide for depreciation, and give a reasonable return on the share capital. A mixed lighting and power load will tend to increase the load factor and give a lower cost per kWh.

The provision of a suitable power load is everything to the small station supplying a rural district, and upon this provision the success of the station depends. If no power load is possible, the cost per kWh for lighting may become so excessive as to prohibit the use of electricity. In small power stations the lighting load must be extensively and judiciously cultivated. It is useless working up a load that gives a very high peak load for one or two hours and a very small average load for the remainder of the twenty-four. Buildings, such as hospitals, theatres, municipal refuse yards, and bakeries that would yield a good load outside the peak-load period should be well canvassed. It is to the day power load that the sales engineer must give special attention. His sales campaign in this direction must be thorough and extensive, and as a part of his plan the relative importance of canvassing and advertising must not be overlooked.

To consider the two individually:—

Canvassing.—Form letters to prospective consumers are useful as an introduction to business. Their wording should be such that the reader's attention is gained at the start. They should be full of live interest and sound argument. Individual letters can be used in special cases or to follow up form letters. This sort of canvassing costs little, and is productive of good results.

An individual letter that resulted in business is given below as an example. It was sent from the sales engineer of a small supply company desirous of increasing his power load to the owner of a motor garage and workshop. It ran:—

"If you were offered £25 for nothing, would you refuse it? This is the essence of my offer to you.

"You have an oil engine of 2½ horse-power working on an average 24 hours per week. To run this costs you roughly £50 in the year. Much of this outlay is wasted. When you have only occasional use for your machines you must either keep your engine running and doing no work or else be constantly stopping and starting it. This is not only inconvenient, it is uneconomical. It means loss of time and money. You cannot start your machines immediately if your engine is shut down.

"With an electric motor this is avoided. You can start and stop it when necessary without loss in time or money. Moreover, there is no noise or smell.

"*Electric motors save money.* Sell your oil engine to a less enterprising man than yourself. You could probably obtain £40 for it, and with this you could buy a motor of equal power.

"Assuming the amount of work done by the machines to be the same, you would effect a saving of about 15 per cent. in the number of hours worked. At 3d. per unit the motor would cost you £25 per year to run, thus saving £25.

"This is the £25 I offer you. Will you accept it?"

Advertising.—As an indirect method of securing business, advertising is the only satisfactory one. The results obtained from general advertising are not easily estimated, but there is no doubt that a scheme well advertised pays. The question is, to what extent shall advertising be carried out? It costs money, and in a small power station the amount available for advertising cannot be large. The sales engineer has to decide, therefore, how best to expend the money allotted to him.

A small attractive advertisement in the local papers recommending the use of electricity for various purposes is useful.

A still more attractive advertisement is the "talking sign." This is one that appears letter by letter until the advertisement is complete, and then blotted out, the whole operation being repeated for as long as required. Such phrases as "Use electricity," "Electricity for lighting and power" displayed in some conspicuous part of the town attract attention, and, by their continual repetition, impress themselves upon the mind of the observer. These signs are not expensive to construct, and if well designed consume a minimum of energy.

Flashing signs are also useful and somewhat cheaper both in the cost of construction and operation, but their use as an advertising medium has not such far-reaching results as that of the "talking sign."

If the company has a town office, an attractive window display will also prove of value. It is here that electric comforts and labour-saving devices can be shown and operated. An enterprising sales engineer will give special attention to this display. It interests prospective consumers and produces good results with little expenditure. Interest once created, the demand soon follows.

In conclusion, the following figures are given as an example of what is possible in small power stations.

The case is that of a station of 200-kilowatts capacity. The share capital of the company is £25,000, made up of 10,000 £1 preference shares bearing interest at 6 per cent., and 15,000 £1 ordinary shares. To meet capital and recurrent expenditure all the preference shares have been allotted and 12,000 ordinary.

Capital expenditure is made up as follows:—

	£	
Purchase of land	500	
Buildings	2,500	(1)
Two 100-kW generating sets (oil engine)	6,000	(2)
Switchboards, switchgear, & instruments	500	(3)
20-kW, 220-volt battery	2,000	(4)
Cable	3,500	(5)
Meters	1,500	(6)
Foundations	200	(7)
Poles, &c.	720	(8)
Fittings for street lighting	135	(9)
Incidentals	100	(10)
	£17,655	
Preliminary expenses	1,000	
	£18,655	

Annual expenditure is:—	£
Fees to four directors, at £50	200
Engineer and manager	400
Outside engineer	300
Two linesmen	440
Four power-house attendants	840
Fuel oil	1,800
Oil, stores, &c.	400
Repairs, renewals, &c.	200
Overhead charges:—	
Clerical staff	575
Meter reader	150
Insurance	145
Advertising	200
Rates and taxes	30
Stationery, postage, and sundries ...	250
	£5,930

The earning capacity of the station is based on a load factor of 25 per cent. In the diagram (fig. 1) the load curve for a period of 24 hours in December is given.

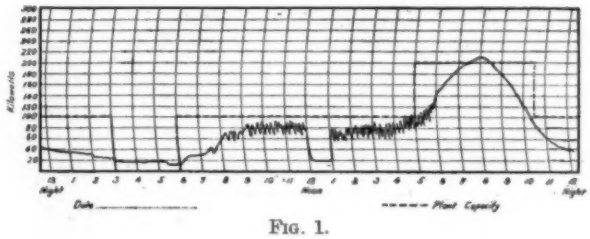

FIG. 1.

This diagram shows a load factor of 37 per cent., which might reasonably be expected to fall to about 18 per cent. for the summer months.

At 25 per cent. load factor (average) the output of the station is 438,000 kWh. Allowing 10 per cent. loss in transmission, the resultant number of kWh sold will be 394,200. At 5d. per kWh (average for lighting and power) the earning capacity of the station is £8,212. Add to this rent for meters, estimated at £180, and the total revenue becomes £8,392.

Depreciation is allowed for on items 1 to 10 at 5 per cent.

On trading, therefore, we have the following:—

	£		£
Annual working expenditure	5,930	Total revenue	8,392
Depreciation	857		
Profit	1,605		
	£8,392		£8,392

Out of profit, 6 per cent. on £10,000 is distributed as dividends to the preference shareholders. This leaves a balance of £1,005. On the ordinary shares a dividend of 7 per cent. might be declared, leaving a final balance to be carried forward of £165.

Reference to the load curve shows that between the hours of 7.30 a.m. and 5 p.m. there is a good power load, but during this period the maximum capacity of one set is never reached. The sales engineer should aim at increasing the load during this period to the full capacity of the set. This would provide a further consumption of 152,685 kWh per annum, which, at 3d. per kWh, would bring in an additional £1,908 revenue. The additional cost for generation might amount to £930, thus giving a further clear profit of £978.

Electric Railway Signalling in Russia.—Recently, at the Petrograd factory of the Weak-current Electric Trust, the production of railway signalling equipment has been considerably increased. This factory produces 95 per cent. of the country's demand. The factory is engaged in preparing electric signalling on the Alexandrovsky, Kursk, Southern, Ryaz-Ural, and other railways. The management of this factory is studying systems of electric railway signalling with the intention of using and combining the best systems.

LEGAL.

Tomlinson Lee v. Peel.

SLANDER ACTION BY ELECTRICAL ENGINEER.

MR. JUSTICE DARLING and a special jury, in the King's Bench Division, on May 3rd, had before them an action brought by Mr. Harry Tomlinson Lee, ex-chief electrical engineer for the borough of Wimbledon, against Mr. William Nicholson Peel, an alderman of the Wimbledon Town Council, claiming damages for alleged defamatory words spoken and published concerning the plaintiff as an electrical engineer. By his defence, defendant denied that he spoke or published the words complained of within the meaning alleged, and said that if he did so they were spoken on a privileged occasion, and, alternatively, that they were true in substance and fact.

Mr. H. Maddocks, K.C., and Mr. H. Jacobs, appeared for the plaintiff, and Mr. Holman Gregory, K.C., Mr. J. D. Cassels, and Mr. C. A. Collingwood for the defendant.

MR. MADDOCKS, opening the plaintiff's case to the jury, said plaintiff was until January 31st of last year, chief electrical engineer for the Wimbledon Town Council. He had been in the Council's employ about 20 years, and on January 31st, 1922, he was summarily dismissed. He was paid his salary for four months and told he was no longer to attend at the works. When the matter came before the Council, no reason was given why he should be dismissed, and no reason had been given to that day.

In 1919, when a new chairman of the Electricity Committee was appointed, the chairman read him a little homily as to his general behaviour, in which it was said that the Committee had arrived at a unanimous decision to increase his salary. It further said among other things that the Committee had to remind him that the Council required its officials "to abstain rigorously from taking any part in local elections," and "earnestly advises you to abstain from intoxicants."

With regard to his taking part in any election, the Mayor asked Mr. Lee to lend him a car, and Mr. Lee lent him one. Who could blame him for that? As to intoxicants, nobody could say that Mr. Lee was addicted to drink. Notwithstanding the homily and allegations, in May, 1920, they gave him another £100 a year. Not a word of complaint was made to him after that homily was read to him, until suddenly in January, 1922, he was informed that he had to go. He asked if he had done anything unprofessional, and the answer was "No."

Mr. Peel was one of those who voted for Mr. Lee's dismissal. A petition was signed by two thousand people asking for an inquiry. That the Council refused. On March 5th, at the South-Western Hotel, Wimbledon, Mr. Peel said to Mr. R. D. Pond, one of the signatories to the petition, "Lee ought to have been dismissed ten years ago. He is incompetent for his job and ought to be sacked." That was one of the slanders complained of.

Mr. Pond asked: "Has he been drunk, or embezzled the Corporation's money, or been leading an immoral life?". Defendant said "No," and Pond turned away saying: "I am hanged if I understand you." The following day there was a meeting of the Council, at which Alderman Peel said that the Committee had invited Mr. Lee from time to time to change his ways, and had warned him. That was absolutely untrue. Mr. Peel claimed privilege in respect of it, but a privileged occasion must not be abused by making a statement that went beyond fair and proper speech. Mr. Lee had not been warned from time to time, and there was no reason why he should be dismissed. There was a by-election at Wimbledon, and Mr. Peel was interested in it because his father-in-law was a candidate, and Mr. Heaton was opposing him. So keen was the feeling at Wimbledon that this matter of plaintiff's dismissal was made one of the "planks of the platform." Heaton supported Lee, and the other candidate the Council, and his son-in-law's action.

Another member of the Council and defendant went round canvassing, and one elector would say that he was told that in the best interests of the Council they ought to dismiss Mr. Lee, but in view of his long service and for the sake of his family they wanted to make the consequences as light as possible for him, and therefore they were not stating any reasons for his dismissal. The innuendo was that if reasons were given for his dismissal, it might do him a big injury—knowing as they did all the time that there were no reasons for his dismissal. An action was brought by the plaintiff against the Mayor, Mr. Mussell, on the words which were said in the presence of Mr. Peel—"Those who wanted to do Mr. Lee the best service should not press for definite reasons." No justification was pleaded, but what was pleaded was that the mayor was protected by privilege.

HIS LORDSHIP: What became of the action against the Mayor?

COUNSEL: A verdict for the plaintiff for £250.

MR. MADDOCKS, continuing, said defendant gave particulars of the matters he alleged against plaintiff. One thing was that in 1921 Mr. Lee having extended the electricity undertaking to different places, was asked about a further extension. He made a report. He was looking ahead and his figure came to £130,000. He recommended the Council

to have a consultant, and Messrs. Sparks & Partners made a report, in which they suggested temporary matters at a cost of £9,000. It was put against Mr. Lee that that was one reason justifying his dismissal.

Evidence was given by Mr. Ralph Dixon Pond in accordance with counsel's statement.

Plaintiff, giving evidence, said that when the Mayor told him that the Electricity Committee had come to the conclusion that the Council and he must part company, he asked for a reason and could not get one. He was never invited to attend any Committee meetings to answer any charges, and Mr. Peel never asked him to explain his conduct.

Mr. Gregory (cross examining): Would you be surprised to hear that since you left it has seldom been necessary to use more than four boilers if they were kept clean?—No. The coal question was very serious in 1920, and the coal obtainable was very little better than dirt.

Instead of a loss you estimated, in 1922 there was a profit?—I was responsible for that profit.

Witness said he estimated for a loss under certain conditions. It would surprise him to hear of an estimated profit of £27,000.

Mr. Gregory: Practically the whole of the difference is arrived at by cleaning the boilers and keeping them clean?—Nonsense.

How do you think the difference is arrived at?—Primarily, the cost of coal; you can get better coal at much lower cost. Wages are down by nearly half, and other incidentals not looked for in 1920, of which the present management got the benefit. He was estimating as if they were not anticipating any increase or reduction.

Mr. Justice Darling: You advocated raising the 8d. rate to 10d.?—On prime costs for labour and material, but since then costs have come down. Other electricity undertakings are making big profits at the present moment.

Witness in further answers to Mr. Gregory's questions denied that he had ever given way to drink. He said he had never been under the influence of drink.

He had never been spoken to by people connected with the Corporation about giving up drink. The only Committee reference to drink was in the homily of 1919. The last time he took intoxicants was in September, 1920.

The hearing was adjourned.

At the resumption of the hearing, on May 4th, replying to further questions by Mr. Holman Gregory, plaintiff denied that he used bad language in referring to members of the Electricity Committee and officials.

Did Alderman Stewart, in November, 1920, tell you that the question of your basic salary had been before the Committee and that its consideration had been deferred?—Yes.

Did he tell you that that step had been taken because the Committee were dissatisfied with the way in which you were doing your work, and the way in which you were drinking?—He did not put it like that. He said they were not favourable to the increase although he was in accord with it, and that they had brought the question of drinking forward. I added to his remarks: "It seems to me they bring this up for no reason whatever, and it is a type of defence they are offering when they do not want to do anything which is just."

Re-examining, Mr. Maddocks asked: From 1919 up to the time of your summary dismissal was any complaint made by the Council against you?—No.

When Alderman Stewart ceased to be chairman of the Electricity Committee in 1917, did he without solicitation give you a testimonial?—He did, and I was surprised and gratified to receive it.

Counsel read the letter of Alderman Stewart, who said no chairman could have been more loyally served than he had been, and that "Wimbledon is fortunate in having such a keen engineer and business manager as yourself."

Chief Inspector C. M. Turner, of Manningham police station, Bradford, said he met plaintiff at the Bradford Convention in 1920, and on all occasions he was with him, plaintiff was sober. He thought plaintiff was nearly a teetotaller, because he drank so little.

Without further evidence being called for plaintiff at this stage, on his Lordship's suggestion, the case for the defence was proceeded with.

Mr. Holman Gregory opening defendant's case to the jury, said his client was there to say that Mr. Lee was dismissed because the Committee had lost confidence in him, as they had come to a stage when they could not safely act on his advice. The electricity station had got into such a state that it was making a heavy loss. The Committee made a great mistake in not boldly stating that what they were doing was because they had lost confidence in him. They thought it would be to his interest not to define the reasons for his discharge, and they did not.

Knowing that he was an able man and that for some years he had done his work well, they were driven to the conclusion that the condition of his mind and the position he was in were the result of the life he had been leading for the last few years. He, Counsel, was instructed that plaintiff spent a great deal of time in public houses, and unfortunately his weakness made him irritable. He resented friends' efforts to help him, and he used bad language. The justification for what the Committee did was in the position of the works to-day. The works had been run at an increasing profit from the moment he left.

Mr. Arthur Edwin Mackenzie, the present manager of Wimbledon electricity works, said he attended on sub-poena. The maximum output at the works during the winter prior to his appointment in April, 1922, was 2,725 kilowatts, the coal consumption being higher than it should have been. The old boilers were in a filthy condition, and he had them cleaned. The effect was to bring about a decrease in the coal consumption per unit generated. During last winter the maximum load was 3,700 kilowatts. He got a higher output for less coal consumption per unit. The price per unit was 8d. when he took charge, and in September, 1922, it was reduced to 7d., and in April this year to 6d.

Mr. Gregory read a statement that in 1917 the works were worked at a loss of £4,220; 1918, £380 profit; 1919, £3,023 loss; 1920, £1,629 profit; 1921, £3,699 loss; and for 1922, that was just before witness went to the works, a profit of £5,894.

Witness said he estimated a profit for 1923 of £25,000. Witness further said that his predecessor used water from the river Wandle. He had nothing to say about that, but it wanted treatment to prevent the scale-forming matter from entering the boilers. The water-treating plant was not working when he took over his duties. He had it repaired and used it. He used at the works ordinary drinking water from the town mains.

Cross-examining, Mr. Maddocks asked: You don't attribute the wonderful development in the generating station to Mr. Mackenzie?—Yes.

Mr. Maddocks: Wages have dropped, coal has come down in price, coal strike stopped, all on account of Mr. Mackenzie?—No.

It is not all due to you?—Not all.

The hearing was adjourned, and was resumed on May 7th.

Mr. Charles Sparks, senior partner of the firm of Messrs. Sparks & Partners, consulting electrical engineers, said in January, 1921, he was instructed to report upon the Wimbledon electricity plant. He made inquiries as to the internal condition of the boilers, and plaintiff satisfied him that they were in a reasonably good condition.

Mr. Alfred Sheldon, formerly Town Clerk to the Wimbledon Town Council, said he never saw plaintiff drunk in the ordinary acceptance of the word, but he had seen him on occasions when it was quite evident he had had drink. Since September, 1920, after plaintiff recovered from an illness, he had not seen any signs of intoxication.

Defendant, giving evidence, said the statement which he was said to have made on March 2nd, 1922, of which complaint was made, was substantially true. The words which he was alleged to have spoken in a Wimbledon hotel were never uttered. Mr. Pond asked him why plaintiff was dismissed, and witness said to him that, so far as he knew, members of the Electricity Committee and the Council had lost confidence in him. That was said in a whispered conversation. All that he said to Mr. Temple in answer to his question why plaintiff was dismissed was that, in his opinion, the Committee and the Council had lost confidence in him.

Cross-examined: Witness said he never suggested plaintiff was dismissed for intemperance. There was an accumulation of reasons from 1909 to the time he was dismissed.

Mr. Maddocks: Do you know that not one word of Messrs. Sparks & Partners's report reflected on plaintiff?—No.

Would you say he is incompetent?—I don't want to say, as a technical engineer, he is incompetent.

You say he is unfit?—Yes.

The hearing was adjourned.

Irish Kinematograph Co. (1920), Ltd., v. Wm. Coates and Son.

Following a hearing extending over three days, a Dublin City special jury, before Mr. Justice Pim, in the Irish Free State High Court, assessed damages, £90, against defendants, electrical contractors, Leinster Street, Dublin, in a suit by the plaintiffs for, as alleged, breach of contract in relation to the sale of a motor-generator and accessories for a city picture house. His Lordship granted a stay of execution. The question in dispute was as to whether the generator could produce a steady arc suitable for kinema use.

The Postmaster-General v. Sharp.

At Halifax County Court, last week, before Judge Bairstow, application was made on behalf of the Postmaster-General for consent, under the Telegraph Acts, to lay an underground cable in Lee Avenue, Skircoat Moor Road, in the face of refusal of permission by Alphonse Sharp, owner and occupier of a house in the avenue. Other property-owners concerned had given permission. It was a private road, with a barrier at one end. Mr. Sharp was prepared to consent on payment of 5s. per year, but the Postmaster-General refused that proposal, contending that he had the right to lay the cable without payment, it being claimed that the avenue was a public road. The Halifax Borough Engineer (Mr. A. C. Tipple) said the road was lighted at public expense, and the public had had

twenty years' right of way, but he admitted that the Corporation would not repair the footpath if it required it. His Honour gave consent for the cable to be laid, holding that the road came within the definition of Section 3 of the Telegraph Act, 1892.

The Postmaster-General v. Winder.

At Lancaster County Court, last Friday, the Postmaster-General applied for consent to lay a duct and cable along the back of Seaburn Road, Bare Morecambe. Mr. W. A. Winder, of Broad Street, Bradford, the owner, opposed. His Honour Judge Bradley, in making an order for the cable to be laid, said that when a man was forced to give up his rights by statute he (the judge) did not feel inclined to enforce costs, and in this case he would not do so.

Alleged Radio Apparatus Fraud.

At Newcastle Police Court, on April 24th, Charles Jack and Leslie Bruce Machin were charged with conspiracy to defraud Marconi's Wireless Telegraph Co., Ltd., Alfred Ellis and Co., Ltd., and others, in connection with the purchase of radio apparatus and other electrical accessories to the value of £300.

For the prosecution, it was stated that Jack had been before the Court previously, charged with obtaining credit by fraud and false pretences. The evidence then brought forward led to further investigation which pointed to the complicity of other persons. This prisoner had traded as the Gateshead Wireless Co., and as the Jack Cinema Co. Machin traded under the style of the Tyne Electrical Co. Under these names large purchases of electrical materials had been made and these were immediately disposed of. When the position of any one of the "companies" became the subject of inquiries, the two accused, by a mutual arrangement, acted as sponsors for one another. Further inquiries were pending regarding other persons who had obtained goods from the accused at very low prices. After the hearing of further evidence a remand was ordered. Bail was refused.

CORRESPONDENCE.

Letters received by us* after 5 p.m. on Tuesday *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Cleanliness in Wiring.

As an old stager, it is very amusing to read the correspondence with reference to the above. The alleged innovation by your correspondent has been in practice by our firm for the last 40 years, except as regards the white overalls.

Lowdon Bros. & Co.

Dundee, *May 5th*, 1923.

[A firm that was established in 1876 and is still "going strong," may be counted on to know all that is worth knowing about wiring work.—Eds. Elec. Rev.]

Motor-car Wiring.

I have been lately called to several instances of faulty wiring on motor cars, and I feel prompted to ask if there is a really satisfactory make of cable to use on motor-cars—a cable that will stand oil, heat, water, dirt, and vibration, one that I could safely guarantee for five or ten years.

Inquirer.

May 6th, 1923.

Power Factor.

I note that your correspondent, Mr. W. E. Rogers, in his letter of the 27th inst., makes reference to certain types of single-phase motors as aids to power factor improvement; presumably he refers to the commutator type of machine with shunt characteristics, as made by the Electro-Dynamic Construction Co., Ltd.

This type of motor has a unity power factor on full load, and is a direct opposite to the induction motor inasmuch as the power factor increases as the load decreases, a fact which should commend itself very strongly to power-station engineers.

The full-load power factor being unity, can very easily be demonstrated by the wattmeter and volt-ammeter method. The no-load power factor can of course be checked in the same way, but the above method will not indicate whether the power factor is leading or lagging, and in the absence of a power-factor indicating meter I suggest the following very simple but conclusive test:—

Connect the commutator motor to be tested and an induction motor in parallel, with an ammeter in the common circuit.

The light-load currents of the two machines should be noted separately.

It will be apparent that if both machines have a lagging power factor the current indicated when both machines are running simultaneously will be greater than for one machine, the actual reading being dependent on the angles of lag of the respective machines.

Now if the induction motor be started up and the current noted, then the commutator motor started, and if the current diminishes instead of increasing, it is obvious that one of the machines has a leading and the other a lagging power factor—and no one will accuse the induction motor of the former attainment.

E. J. Timberlake.

London.

Referring to the letter from Mr. W. E. Rogers, on the above subject, in your issue of April 27th, we have for a long time been convinced that steps must be taken to improve the power factor of industrial motor loads, and that the best way of doing it is to deal with the trouble at its source, *i.e.*, our old friend, the induction motor.

We have made some headway, and hope to get further yet. Up to date we can offer single-phase commutator-type motors which will operate at *leading* power factor at light load and unity power factor at full load. Also a polyphase motor (without commutators) in sizes over 30 h.p., which can be arranged for a power factor of 0.7 leading or for unity power factor.

These are commercial and practical machines at reasonable cost, not freaks, and they are available for Mr. Rogers or any one else who wants them.

Industrial Electroplant, Ltd.

Westminster, *May 7th*, 1923.

Mr. W. E. Rogers raises several interesting points in your issue of April 27th. While generally in agreement with him, I would like to reply to a few of his statements and queries.

(1) Leading power factor on lightly loaded single-phase commutator motors is obtained with a certain type of commutator motor. In order to actually demonstrate that such a motor was running with a leading power factor a power-factor meter would be necessary. This would indicate both leading and lagging power factor.

(2) Supply authorities advising consumers.

(3) Supply authorities leaving consumers' power installations in contractors' hands.

These two points as far as power consumers are concerned certainly demand attention, but it is very doubtful whether the majority of supply undertakings are in a position to give this service. There are, of course, some which can and do, but the majority do not, and perhaps it is as well, for one wonders what would happen if *some* supply engineers had the control of consumers' installations and were free to impose their particular fads and fancies on them.

Again, there are some suppliers who run sales departments of their own, and the official in charge of such a department in his anxiety to obtain the consumer's order for a power installation, and to cut out his competitors (the electrical contractors), is too often disposed to buy the cheapest motors he can find without giving a thought to any other considerations.

It is true that the *average* electrical contractor is not an expert on power jobs. One therefore comes to the conclusion that the best results, both from the consumers' and the supply authorities' points of view, would be obtained by employing a firm of specialists in power application; let the contractor or other competent party carry out the actual wiring work, but leave the choice and layout of suitable motors and the arrangement of the drives to the power specialist, who will not be influenced either by the supply engineer's or the contractor's particular point of view, but who will provide a plant which will give satisfaction and uphold his reputation as a power specialist, who is free from any local or sectional influence, and who has a proper knowledge of the consumers' and the supply undertaking's needs.

The engineering staff of supply undertakings generally have no time to make a special study of the industrial application of electric power, and all the detail considerations this involves, so that most suppliers when up against this subject could with advantage avail themselves of the services of a power specialist.

(4) Mr. Rogers will no doubt be pleased to note that there are a fair number of suppliers now offering kVA tariffs and combination tariffs based on maximum demand, coupled with the use of high-power-factor apparatus.

F. G. H.

Peckham, *May 7th*, 1923.

Costing.

The review of Mr. Workman's book on "Costing Organisation for Engineers," in your issue of April 27th, brings out a point which, I think, calls for a little comment.

It states, *inter alia*, that "carriage outwards and packing is without question a factory overhead charge; in fact, in many cases, such as carriage and packing on a turbo set, it need not be an overhead charge, but a direct charge to the particular job."

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To include "carriage outwards and packing" in the factory overhead expenses means their inclusion in the factory cost of the goods produced, with the result that the cost of production would be different in the case of a piece of apparatus built for shipment to India and in the case of an exactly similar piece of apparatus built for shipment to a site only a few yards from the factory.

In the first case both carriage outwards and packing for export would be considerable items, whereas in the second case both would be almost negligible; whilst, on the other hand, the cost of producing these goods and turning them into stock would be identical.

The distance the goods have to be sent to the customer and the type of packing to be used are matters of salesmanship and, therefore, their cost should be categorised as selling expenses.

On the other hand, it may be worth mentioning that carriage inwards on raw materials, &c., enhances the price of such materials and is justly a part of the cost of production.

It is well to differentiate between charges to particular contracts and charges to their factory cost, *i.e.*, between the overall cost and the cost of production.

In order to arrive at the gross profit arising from the sale of a certain piece of apparatus, it is theoretically sound to charge the cost of carriage outwards and packing to the trading account or cost and sales account covering the contract, but as a special selling expense, and not as a part of the factory cost.

This may be done where the selling units are of a large order, but where a factory turns out a variety of large and small products, carriage outwards and packing are best split up, under two headings. For the large products they are chargeable as a special selling expense for each contract. For the smaller products their total cost is included as an item of selling expense in the office oncost, thereby obviating the considerable unwarranted clerical labour which would be involved in their exact allocation.

F. C. Lawrence,
Consulting Cost Accountant.

Manchester, *May 4th*, 1923.

Government and Inter-Imperial Trade.

In the timely leader of your issue of April 20th, under the title "Government and Inter-Imperial Trade," occur the following words:

"The economic conference that meets in October this year, and at which all the Dominions will be represented, is intended to be a practical one which shall achieve a more definite result than the mere passage of pious resolutions."

May I suggest that one of the best ways to achieve "definite results" would be for the conference to devote part of its time to receiving from traders evidence of difficulties they are actually encountering.

If the Government were to invite the various Trade Associations each to suggest subjects for discussion, and to appoint one or more members to wait on the conference to give evidence when called upon, first-hand information would be obtained, which I am sure would result in much good work being accomplished.

That there is a vast fund of mutual goodwill in this country and the Colonies is a fact which cannot be disputed, but, being connected with a firm which for many years has carried on an extensive export trade, I can testify that there are regulations both in this country and the Colonies which tend to make trading within the Empire more difficult for the Britisher than for his Continental competitor.

The first step towards the removal of such difficulties is to ensure that they shall be effectively stated in the proper quarter, and if through your pages you can influence the authorities to adopt some plan such as I have outlined to enable the trader to make his voice heard, you will be assured of his gratitude.

W. G. Newberry.

Eltham, *May 7th*, 1923.

Can the "Maximum" Price be Exceeded?

Do you know of any instance of an undertaking with statutory powers obtaining by special agreement a price higher than its maximum statutory price by reason of special extensions of main, or other special circumstances?

This matter of price limit is dealt with under Schedule Section 32 of the Clauses Act (1899), and Sections 19 and 20 of the Electric Lighting Act (1882), from which I gather that a higher price cannot be obtained without sanction.

Schedule Section 27 of the Clauses Act, 1899, enables a minimum revenue of 20 per cent. for two years to be obtained.

I have recently been offered by a consumer some considerable distance from our main (by special agreement) 1s. per unit instead of this 20 per cent. minimum (our present maximum price being 8d.), and under Schedule Section 33 of the Clauses Act, 1899, I am told I can accept this.

I should appreciate your views, or those of your readers.

Electricity Supply Engineer.

May 7th, 1923.

[Schedule Section 33 says: "Subject to the provisions of the Special Order," and therefore, we think, does not permit of exceeding the maximum price per kWh there stated; but it would appear feasible to charge 8d. per kWh plus a lump sum per quarter, or some other tariff equivalent to 1s. per kWh, without exceeding one's powers. It should be remembered that the Electricity Commissioners have secured wide powers under the Act of 1922, with regard to tariffs, and we suggest that they should be consulted.—Eds. Elec. Rev.]

BUSINESS NOTES.

Bankruptcy Proceedings.—J. Harris, electrical and general engineer, King's Head Buildings, Church Street, Nuneaton.—Receiving order made April 30th on debtor's own petition. First meeting May 15th, at the Official Receiver's office, 9-11, High Street, Coventry; public examination June 11th, at the County Hall, Coventry.

G. F. Coupe, electrical engineer, 2, Spring Gardens, Stockport.—Trustee, Mr. J. G. Gibson, Official Receiver, Byrom Street, Manchester, released March 12th, 1923.

F. J. Martland (F. Martland & Co.), electrical engineer, Albion Yard, Millgate, Wigan.—Trustee, Mr. E. D. Symond, Official Receiver, 11, Dale Street, Liverpool, released April 6th, 1923.

Albert William Verity, of 10, Peach Street, Bradford (lately carrying on business as an electrician at 143A, Leeds Road, Bradford, in partnership with Hubert Lee, as "Verity and Lee").—At Bradford County Court, on May 3rd, a receiving order was made.

Samuel Ernest Needham, trading in partnership with three other persons at 20, Park Road, and 131, Benton Way, Wallsend, electrical and mechanical engineer.—The first meeting of the creditors of the above was held on May 2nd at the Official Receiver's office, 4, Northumberland Street, Newcastle-on-Tyne. According to the statement of affairs the gross liabilities amounted to £325, of which only £17 was expected to rank. The Official Receiver pointed out that the creditors of the firm could not prove against the separate estate so long as there was any joint estate or solvent partners who could be sued. It appeared that debtor commenced business in February, 1919, at Wallsend, as an electrical and mechanical engineer with £32 capital. He entered into partnership with three others on June 1st, 1922, and they commenced trading as S. E. Needham & Co. One partner had paid in £300 prior to the partnership, another had transferred a motor chassis (estimated at £100) prior to the partnership, and the third introduced £200 after the deed of partnership was signed. Debtor's capital was agreed at £750.

Stanley James Watson, formerly carrying on business with others as the Vulco Magneto Co., at 11, Long Acre.—This matter came before Mr. Registrar Mellor on Tuesday, at the London Bankruptcy Court. The firm failed in June, 1921, with provable debts £2,832, and assets which realised £21. The partners have passed their public examination, and one of them has obtained a discharge from the proceedings. The examination of the debtor Watson had stood over, on the application of the Official Receiver, who required further information and accounts. The debtor was now examined by Mr. D. Williams, Official Receiver, regarding his banking accounts, and particularly as to the disappearance of a sum of £1,000. No satisfactory explanation could be obtained from the debtor, and eventually Mr. Williams asked for the examination to be adjourned, *sine die*, on the ground that the debtor had not fully disclosed his affairs to the Court. The debtor protested against such an order, and his solicitor pointed out that the debtor had given all explanation and information in his possession. The Official Receiver complained that throughout he had received very little assistance from the debtor, and that day he had disclosed for the first time the existence of a banking account at Manchester. The Registrar said he would conclude the examination, although he regarded it as being most unsatisfactory, for the sense of the Court would be shown when the debtor applied for an order of discharge. The examination was accordingly concluded.

R. Walker, motor engineer and electrician, West End Garage, Peacock Cross, Hamilton.—Public examination May 11th, at the Sheriff Court House, Hamilton. Meeting of creditors August 2nd, at the offices of Messrs. McMillan and Henderson, 13, Dundas Street, City, Glasgow.

Company Liquidations.—ANODE WIRELESS AND SCIENTIFIC INSTRUMENTS, LTD., described in the compulsory winding-up order as electricians and manufacturers of generators and other electrical instruments, 265, Strand, W.C.—Meetings of the creditors and shareholders were held last week at the Carey Street offices of the Board of Trade, Lincoln's Inn, W.C., when it was resolved to leave the liquidation in the hands of the Official Receiver.

The Chairman reported that the company was registered on October 6th last with a nominal capital of £30,000 in shares of £1 each, and was formed to take over as a going concern the goodwill of the business formerly conducted by Anode, Ltd., and to carry on business as above. The company was promoted by Pherozshaw Ruttenjee Minvalla, Walter Ernest Peek, and Albert Henry Lunniss. The total issued capital was £7,323, of which £1,825 was allotted for cash, and the balance as fully paid. The register certificate authorising the company to begin business was issued on October 17th, and, three days later, the company entered into an agreement with Anode, Ltd., for the purchase of the business which had been started by Peek and Lunniss in 1919, together with all plant, office furniture, and patents and benefit of all pending contracts, for £6,300, to be satisfied as to £800 in cash, and as to the balance in fully-paid shares of the company. The shares were duly issued, but only £200 of the cash had been paid. The business was carried on at 47, King's Road, Camden Town, with registered offices at 265, Strand, W.C., but in consequence of the shortness of capital, promises to provide further sums being unfulfilled, the company, on January 19th, passed an extraordinary resolution for voluntary liquidation, with Mr. E. S. Howard, C.A., 56, Budge Row, E.C., as liquidator. The failure and insolvency of the company was attributed by the secretary to lack of capital to carry the company over the initial stages, during which, in his opinion, it was bound to run at a loss. Mr. Peek, Mr. Lunniss, and Mr. Reynen concurred, and added that the company was started on a £10,000 capital basis. On January 6th the first two gentlemen asked the company for payment of the balance of the cash portion of the purchase consideration, or failing that, the return of goods bought from Anode, Ltd., and the board decided that as the company was unable to pay the cash they should be allowed to take over plant, &c., of the value of £600, which they did. But, on the Official Receiver pointing out that this transaction constituted a fraudulent preference, and that it would probably be set aside by the Court, they voluntarily and very properly surrendered the goods, which had since been sold by auction for the benefit of the creditors generally. According to the statement of the company's affairs that had been lodged, the liabilities amounted to £2,444, of which £1,576 were returned as expected to rank, while the assets were estimated to realise £441, after payment of the preferential claims, amounting to £266. A total deficiency of £8,458 was disclosed with reference to the shareholders. These figures, however, did not now show the position accurately, because of the voluntary action of Mr. Peek and Mr. Lunniss, to which he had referred, which increased the amount of the assets available for distribution among the unsecured creditors, whose claims would be increased too, by that action.

The following are the principal creditors:—

	£		£
American Hard Rubber Co. (Britain), Ltd.	85	Minvalla, P. R.	87
Anglo-Swiss Press	28	O'Kill, G.	22
Bertram Day & Co., Ltd. ...	25	Peek, W. P.	23
Broadwood & Sons, Ltd. ...	14	Reyner, J. H.	50
Brown, S. G., Ltd.	19	Surrey Scientific Apparatus Co., Ltd.	11
Dubilier Condenser Co. ...	30	St. Helen's Cable and Rubber Co., Ltd	25
Fairley, W. E.	28	St. Pancras Borough Council ...	16
Graham, A., & Co.	39	Tanner, G. W.	18
General Electric Co., Ltd. ...	61	Varley Magnet Co., Ltd. ...	30
Grey, C. L.	43	West End Engraving Co. ...	24
Hervé, L., Ltd.	40	Wilson, J. R.	25
Igranic Electric Co., Ltd. ...	176	*Partly paid*—	
Idris & Co.	371	Anode, Ltd.	648
Lunniss, A. H.	10	(Estimated value of security)	600
Matthews Bros., Ltd.	18	Preference	267
Masson, A. F.	77		

BRITISH ILLUMINATED SIGN CO., LTD.—A meeting of members is called for June 11th, at 31, Lombard Street, E.C., to hear an account of the winging-up from the liquidator, Mr. R. Stephens.

Private Arrangements.—HENRY J. BREWSTER and JOHN J. CAPLE, trading as Henry J. Brewster & Co., 11, Queen Victoria Street, London, E.C., wireless instrument manufacturers and contractors.—The creditors interested herein were called together recently at the offices of Messrs. O. Sunderland & Co., accountants and auditors, 15, Eastcheap, E.C., when a statement of affairs was presented by Mr. C. Latham, which disclosed liabilities of £750, all of which was due to the trade. In addition there was a claim for £600 by the Dickinson Electric Co., which had not yet been admitted. After allowing £80 for preferential claims, the assets were estimated to realise £827, or a surplus of £77. Mr. Latham said that the business was commenced by Mr. Brewster in June, 1915, who started as an engineer and tool manufacturer under the present trading style. Later he was engaged in the manufacture of munitions for the Government, and at the present time had a claim against it for £5,800 for breach of contract. The claim was still being pressed, but the Government denied liability. When the slump in the engineering trade took place, Mr. Brewster turned his attention to the wireless industry. In February, 1922, Mr. Caple was taken into partnership. Last year, when the broadcasting question appeared to be settled, they advertised freely and engaged a staff to cope with the expected demand, but the long-continued delay in settling the matter affected the trade and they were put to a good deal of unremunerative expenditure, to which the present position was largely attributed. A contract had been entered into with the Dickinson Electric Co. for the supply of fittings. That company alleged that the goods were not satisfactory and had refused to accept delivery and had made a claim for breach of contract. After discussing the position, it was decided to confirm the deed of assignment executed to Mr. Latham, while a committee was appointed consisting of the representatives of Messrs. Heath & Co., Ltd., R. Cadisch & Sons, and the India Rubber and Gutta Percha Co. The opinion was expressed that the trustee should endeavour to effect a compromise of the claim referred to. It was also the feeling of the creditors that the trustee should carry on the business in consultation with the committee, as it was considered that if the Postmaster-General was able to effect a fair settlement of the broadcasting situation there was every prospect that the concern would prove profitable and that the creditors would be paid in full.

ALFRED WHITE, electrical engineer, &c., 4, Norfolk Street, Sunderland.—In response to a circular letter issued by Mr. William Davison, C.A., of 36, West Sunniside, Sunderland, a meeting of the creditors interested herein was held on the debtor's premises recently. In the circular calling the meeting it was stated that the present position had arisen entirely through the debtor's experimental department in connection with wireless. His resources were limited, while his efforts to obtain outside assistance had not been successful and certain creditors had commenced proceedings. A balance sheet was presented showing the position as at April 21st last, and this disclosed liabilities to creditors of £1,971, while the bank was scheduled for £365 and there were cash creditors amounting to £98. The assets totalled £2,871, or a surplus of £436. It was stated that the debtor had been in business for some time and on June 30th, 1921, his capital account stood at £489. During the following fourteen months the business was conducted at a profit of £1,395, while the drawings were £520. Since September of last year there had been a loss on the trading of £668, whilst the drawings for the period were £260. It was stated that the profits in the business had been earned almost entirely from general electrical work, and that losses had arisen entirely through expenses incurred in carrying on experimental work in connection with wireless receiving apparatus. The electrical business had been well maintained and the debtor was of the opinion that the wireless department should be realised and that he could then successfully continue the general electrical work. After a short discussion it was unanimously decided that the business should be continued with a view to the payment of the debts in full and that a deed of inspectorship should be executed to Mr. Davison, with a committee consisting of the representatives of the E.G.S. Co., Ltd., the Sun Electrical Co., Ltd., and the Telephone Manufacturing Co., Ltd.

ANTHONY BLAND GREGSON, trading as The Lancashire Electric Co., 56-58, Stanley Street, Liverpool.—The creditors interested herein were called together on May 4th at the offices of Messrs. Foster & Killip, accountants, Liverpool, when a statement of affairs was presented which showed liabilities of £3,116. The indebtedness to the trade was £718, while the bank was shown as unsecured for £1,471, and there was a cash creditor for £927. The claim of the bank was £1,531, but it held a life policy of the surrender value of £60. The assets were estimated to realise £406, from which had to be deducted £131 for preferential claims, leaving net assets of £275, or a deficiency of £2,841. The assets were as follows: cash in hand, £8; stock at cost, £235; fixtures and utensils, £20; electricity deposit, £5; good book-debts, £105; and work in hand, £32. Book-debts of the face value of £109 were written off as bad. The debtor's solicitor reported that his client commenced business in 1919 with £300—his own money—and £1,000 borrowed from friends. Shortly after commencing the debtor had to contend with strikes, and in 1920 a company was formed in which the debtor invested a substantial amount and was appointed the manager. He spent a considerable portion of his time in developing the company's business, leaving his own concern in charge of a manager. Last year the limited company was wound up, and the debtor then devoted his energies to his own business. During the 12 months ended December 31st, 1921, there was a net profit on the trading of £700. The present position was attributed to bad trade and ill-health. After discussing the position a resolution was passed to the effect that the estate should be wound up under a deed of assignment with Mr. Darkin S. Booth, accountant, of 35-36, Exchange Chambers, Bixteth Street, Liverpool, as trustee, together with a committee consisting of the representatives of Messrs. Downs and Davies, the General Electric Co., Ltd., and Higgs Bros. The following are creditors:—

	£		£
Blackwell, F. C., & Co. ...	13	Stewart, Thomson & Patrick, Ltd.	80
Baxendale Bros., Ltd.	22	Davies & Blondiaux	13
General Electric Co., Ltd. ...	66	Benham & Sons, Ltd.	44
White, J. C.	21	N.E.C.T.A., Ltd.	10
Simplex Conduits, Ltd.	14	Gilbert & Co.	12
Higgs Bros.	62	*Liverpool Echo*	13
Macintosh Cable Co.	15		

H. G. Hoad, trading as H. G. Hoad & Co., electrical engineers and wireless apparatus dealers, St. Martin's Court, St. Martin's Lane, London, W.C., and at Ashford, Middlesex.—The creditors interested herein were called together on May 7th, at the offices of Messrs. Westacott, Quaife & Co., accountants and auditors, 155, Fenchurch Street, E.C. Mr. A. E. Quaife submitted a statement of affairs, which showed liabilities of £1,692. After allowing £121 for preferential claims, the assets were estimated to realise £773, or a deficiency of £929. The assets consisted of: Cash at bank, £2 0s. 3d.; stock, £140; accumulator plant at Ashford, £50; machinery and tools, £7; office furniture, £20; household furniture, £100; book debts, £86, expected to produce £75; and goodwill of Charing Cross business, £500. Mr. Quaife stated that the debtor was for many years an electrical engineer with the London County Council, and in 1915 he started trading in St. Martin's Court, with a capital of £150. In the early part of 1919 he entered into partnership with another, but it came to an end after a few months. The partner brought in £500, and it was agreed that he should receive the same amount when he retired. The money was payable by instalments, and £403 was still owing to the late partner. The partnership was properly dissolved and gazetted, and none of the liabilities existing at that time were still outstanding. The debtor commenced trading at Ashford at the beginning of last year. The books were insufficient to enable a detailed deficiency account to be prepared, but there was no doubt that the debtor had been caught badly by the slump, while he spent over £300 on fitting up the Ashford premises. The drawings had been at the rate of £5 a week. The debtor stated that he could not submit any definite offer, but there was a possibility that if bankruptcy could be avoided some of the cash claims would be postponed. The turnover had been about £4,000 per annum, but it had since slumped off. He had tried to make good on wireless, and had been to Eastbourne and other places giving concerts. A resolution was passed in favour of the execution of a deed of assignment to Mr. A. E. Quaife. The following are creditors:—

	£		£
London Electric Stores	240	Gasgoyne, V.	405
Hughes, H. D.	175	Price, Rev. L.	500
Falk, Stadelmann & Co.	20	Hoad, H. E.	120
Lighting & General Traders, Ltd.	14	Cowan, Miss	58
Barnard, J. W., & Haynes ...	17	Cant, A.	30
Longhurst, E.	18	Howes, W. T.	70
		Green, Arthur, & Co.	25
		Symons, J.	14

G. J. C. Thorne and A. H. Thorne, trading as The Lawrance Electrical Trading Co., 159, High Street, Notting Hill Gate, London, W.—The creditors interested herein were called together on May 7th, at the offices of Messrs. Westacott, Quaife and Co., accountants and auditors, 155, Fenchurch Street, London, E.C. Mr. A. E. Quaife submitted a statement of affairs which showed liabilities of £1,101. After allowing £3 7s. 9d. for preferential claims, the assets were estimated to produce £178, or a deficiency of £923. The assets consisted of: Cash in hand, £4 6s. 3d.; stock, £94, expected to produce £45; office furniture, £17; Ford car, £10; and book debts, £166, estimated to realise £104. Mr. Quaife stated that the partnership was commenced in February, 1922, at South Molton Street, as the Lawrance Electrical Trading Co., and also under the style of Thorne Bros. The debtors commenced with a borrowed capital of £100, and they had since borrowed other amounts. The amount of business done was not very great. There had been a loss on the trading, and it appeared to have been a losing concern practically ever since it started. The business was a weak one, and coupled with the absence of capital the present position had arisen. During the discussion which ensued Mr. Quaife stated that the two debtors were registered under the Business Names Act, but he was aware that the name of another gentleman appeared on the debtors' billheads. The gentleman whose name appeared, however, was not a partner, and stated that he did not authorise the use of his name, and when he became aware of the facts he instructed the debtors to discontinue the practice. The drawings had been moderate. The debtors denied undercutting the market, and stated that they had aimed at trading at the usual profits. Two or three creditors stated that they were in favour of the matter being dealt with in bankruptcy, and in answer to Mr. Quaife one of the partners stated that they were prepared to file their own petition. The following are creditors:—

	£		£
A. C. Trading Co., Ltd.	10	Just, E.	62
British Thomson-Houston Co., Ltd.	17	Metropolitan-Vickers Electrical Co.	14
Argyll Press	18	Motolite Dynamos, Ltd.	15
County of London Engineering Co.	50	Stella Lamp Co.	23
Dyna Electric Co.	15	Three Star Accumulator Co. ...	33
Central Ignition Co.	45	Verrichon, A.	12
Henderson Bros.	16	Grigg Eng. Co.	12
		Mills, Rev. A. S.	500

Dissolutions of Partnership.—Copland, Green & Co., electrical factors and agents, Llanwrst Street, Liverpool.—Mr. J. Copland and Mr. A. L. Green have dissolved partnership. Mr. Copland will continue the business.

R. T. Vaux & Son, ironmongers, hot-water and electrical engineers, 12, Fawcett Street, and 8, Bedford Street, Sunderland.—Mr. R. T. Vaux and Mr. G. N. Vaux have dissolved partnership. Mr. G. N. Vaux will attend to debts and continue the business under the same style.

Angus & Munroe, electrical contractors, motor and general engineers, 56, Roxburgh Street, Greenock.—Mr. D. Angus and Mr. P. Munro have dissolved partnership. Mr. Angus will attend to debts and continue the business on his own account.

Trade Announcements.—The Inventions Development Co., late of Rosemary Street, Belfast, has been re-organised and a new company, entitled Inventions Development (1923) Co., has been formed to carry on the business at 1, Union Street, Belfast.

The Central Electrical Co. has commenced business at 58, Cross Street, Nelson, and desires to receive manufacturers' catalogues and price lists.

The Chloride Electrical Storage Co.'s telephone numbers at the Shaftesbury Avenue showroom depot, London, have been altered and are now Regent 8070 and 8071; two new lines, Regent 8072 and 8073, have been added.

Messrs. T. W. Broadbent, Ltd., of Huddersfield, have removed their London office to 17, Queen Victoria Street, E.C.4. All correspondence relating to their London and export trade should be sent to that address.

The Solenoid Regulator Co., Birmingham, has appointed Messrs. Hogan & Wardrop, 88, Golden Lane, E.C.1, as its sole London district agents, and Mr. T. A. Nunwick, 314, Corn and Produce Exchange, Cathedral Street, Manchester, as sole agent for the Manchester district.

Catalogues and Lists.—Multi-Way Earthing Clip, Ltd., 44, Weston Street, London Bridge, S.E.1.—A folder illustrating an earthing clip for use with radio receiving sets.

Sterling Telephone & Electric Co., Ltd., 210-212, Tottenham Court Road, W.1.—Publication No. 255, illustrating and describing a single telephone receiver mounted on a handle. Priced.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C.2.—May price list of electrical supplies, including lighting fittings, conduits, cables and wires, small motors, fans, &c.

Messrs. Walter D. Fair & Co., 43, Sackville Street, W.1.—A series of illustrated pamphlets advertising washing machines, electric fans, small motors, vibrators, &c.

The British L.M. Ericsson Manufacturing Co., Ltd., 67-73, Kingsway, W.C.2.—An illustrated and priced leaflet describing 3- and 4-valve broadcasting receiving sets, with reaction.

The British Thomson-Houston Co., Ltd., Rugby.—Price List No. 5116, illustrating and describing a.c. hand-operated oil-immersed starting rheostats; and Descriptive List No. 4154-C, dealing with ironclad oil-break switchgear (non-drawout type).

The Chloride Electrical Storage Co., Ltd., Clifton Junction, near Manchester.—An illustrated booklet dealing with electric trucks, with special reference to batteries.

The Vector Co., North Wharf, Gordon Road, Ealing, W.13.—An illustrated and priced pamphlet giving particulars of a number of sizes of tubular rheostats.

The Grafton Electric Co., 54, Grafton Street, Tottenham Court Road, W.1.—A priced and illustrated catalogue of a wide variety of electrical accessories and fittings.

The Solenoid Regulator Co., Highgate Square, Camp Hill, Birmingham.—Leaflet A.C.1, describing air-break drum-type star-delta and series-parallel starters; and List S.R.6, an illustrated and priced pamphlet dealing with a number of types of d.c. and a.c. motor starters, shunt regulators, &c.

Messrs. Watson & Sons (Electro-Medical), Ltd., Parker Street, Kingsway, W.C.2.—Folder 55S, advertising the firm's high-frequency apparatus; and a list of second-hand X-ray and electro-medical apparatus for sale. Priced.

Automatic & Electric Furnaces, Ltd., 173-175, Farringdon Road, E.C.1.—An illustrated pamphlet dealing with "Wild-Barfield" stainless steel hardening equipment.

Radio Instruments, Ltd., 12, Hyde Street, New Oxford Street, W.C.1.—A descriptive pamphlet illustrating variable intervalve reaction components, approved by the Postmaster-General. Priced.

Messrs. R. A. Lister & Co., Ltd., 53, Victoria Street, S.W.1.—A catalogue, with a list of reduced prices, illustrating and describing a number of vertical petrol, paraffin, and gas engines.

Mr. Frederick Pratt, 23, Queen Anne's Gate, S.W.1.—An illustrated description of Vanwyk's overload release switche-

Sydney Deputy Manager Served with a Writ.—The deputy-general manager of the Sydney City Council Electricity Department (Mr. S. Y. Maling) has been served by Messrs. Sly and Russell, solicitors, with a writ claiming £10,000 damages on behalf of Williams Bros., Ltd., as agents in Sydney and New South Wales for the Douglas motor cycles. The cause of action arises out of a series of reports issued to the Electricity Supply Committee by Mr. Maling, when acting general manager of the City Council Electricity Supply Department, during the absence of Mr. Mackay in England, regarding machines in use by the department, when tenders were being considered for motor-cycles for use in the department.—*Tenders*, March 21st.

Mining Exhibition.—An International Mining Exhibition is to be held at the Royal Agricultural Hall from June 1st to 14th. On June 4th, Professor Douglas Hay will read a paper upon "Recent Electrical Developments in Coal Mining."

A Show-Card Stand.—Messrs. L. G. Hawkins & Co., Ltd., are providing their distributors of "Miller" lamps with a neat show-card stand. This is of heavy bronzed metal with wording in gold relief. The show-cards provided with it are artistic and hand-tinted; they are changed monthly.

Clayton Boilers.—Speaking at the annual meeting of the shareholders of Messrs. Clayton & Shuttleworth, Ltd., the chairman (Mr. P. W. Robson) referred to the dislocation of the firm's business by the war and the progress of the new industries which had been taken up to replace the loss of the firm's standard business. He said that an equivalent of more than 100,000 h.p. of water-tube boilers was on order or in process of installation. The performance of the first installation, which had been working for some time, had exceeded the highest expectations of both themselves and their customers. These boilers were of distinctive design and fully covered by patents in all parts of the world. They also had no reason to regret their taking up of the manufacture of rolling stock in association with Clayton Wagons, Ltd.

Australian Duties on Wireless Apparatus.—A *Reuter Trade Service* dispatch from Melbourne, states that in view of the importation of considerable quantities of wireless apparatus to meet the demands of amateurs and others, the Customs Department has issued a series of tariff decisions relating to the duties on these. It has been decided that both fixed and variable condensers, crystal and electrolytic detectors, rheostats, inductance coils (honeycomb and coupled coils), intervalve transformers, valve sockets, and complete tuning sets shall be charged 27½ per cent. under the British preferential tariff, 35 per cent. under the intermediate tariff, and 40 per cent. under the general tariff. Valves will be admitted free under the British preferential tariff, but duties of 5 per cent. under the intermediate tariff, and 15 per cent. under the general tariff will be applied to them.

An Inquiry from Italy.—The British Vice-Consul at Savona, Italy (Mr. Harold C. Swan), has reported that a local firm is desirous of receiving quotations from British manufacturers of all kinds of electrical cables. Further particulars can be obtained from the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Reference 19,365/F.W./C.C.)

Russian Electrical Notes.—The Electrical Trust for the Central Region is taking steps at its Kharkoff works with a view to the construction of generators of up to 15,000-kW capacity in connection with the forthcoming orders to be placed for machines of such sizes for certain stations. At its Moscow dynamo works the trust has started the production of electric crane equipment and of tramway motors, for which a large number of inquiries are on hand. Great attention is also being devoted at the "Isolator" works to the production of high-voltage insulators. At the same time measures are being adopted for improving the types of incandescent lamps so as to enable them to compare with foreign-made lamps. The output of the lamp factory, which has a capacity of 17,000 per month, has been reduced to 10,000 lamps on account of the inadequacy of the sales in the present season.

West Midlands District Council.—The annual meeting of the Industrial Council for the Electricity Supply Industry for the West Midlands district was held in Birmingham on May 4th. In the absence, through illness, of Mr. R. A. Chattock (manager of the Birmingham electricity supply undertaking), the chairman, the vice-chairman (Alderman Gregory) presided. A discussion took place on the question of the advisability of all the workmen becoming members of their appropriate trade unions. It was decided to recommend the constituent employing authorities to post notices in their works embodying a resolution of the Council, stating that it was of the opinion that in the interests of all concerned it was desirable that employés should be members of their respective unions, but that there should be no question of making such membership a condition of employment.

For Sale.—Croydon Corporation Electricity Department has for disposal two 300-kW Belliss-B.T.H. lighting and traction sets, with condensing plant and switchgear, two 500-kW Belliss-B.T.H. alternator sets, four B. & W. land-type boilers, &c.

Burnley Corporation invites offers for one 250-kW Belliss and Morcom-Dick-Kerr generating set, &c. The Disposal and Liquidation Commission have been instructed by the Treasury to dispose of the Government's interest in certain patents for the fixation of nitrogen. (See our advertisement pages to-day.)

Staff Dinner.—To mark the completion of 25 years' operations of the company, the staff and several friends of Isenthal and Co., Ltd., were entertained at dinner by the directors at Frascati's Restaurant on May 1st. The staff made a presentation to the directors, which was acknowledged by Mr. Isenthal, who also briefly recounted the activities of the firm during the past quarter of a century. The party then adjourned to the Lyric Theatre, where several boxes had been reserved.

Cable Manufacture in Australia.—The Metal Manufacturers, Ltd., Port Kembla, N.S.W., is now manufacturing aluminium-steel cable, and has already supplied 100 miles to the Victorian Electricity Commission. This has successfully passed all tests.—*Tenders.*

Book Notices.—"Comment Recevoir la Téléphonie sans Fil," by Joseph Roussel. (261 pp., illustrated). Paris: Librairie Vuibert. Price 6 fr.—In this work the reception of radio telephony is described in a simple and practical manner by a French authority upon the subject. The first chapters are devoted to an historical survey of the art, with a general treatment of the technical side. The author then describes step-by-step the construction and circuits of reception sets, loud speakers, and other accessories. The last part of the book is devoted to the productions of individual French firms. We gather, incidentally, that the French equivalent for "listener-in" is "*sans-filiste.*"

"Aluminium Facts and Figures" (80 pp.). London: The British Aluminium Co., Ltd. Price 5s.—An enormous amount of information has been gathered together within the small compass of this pocket book. In addition to many notes and figures relating to the physical and mechanical properties of aluminium and its alloys (with comparisons with other metals, principally copper), the booklet contains information regarding the working of the metal. A useful section is that dealing with aluminium cables, in which are given particulars of the weight per unit length of various sizes, safe currents, overhead line construction, &c. Notes on casting, riveting, soldering, machining, and other operations are given in a section occupying several pages.

The publishers of the *Motor Ship* have issued a handsome booklet setting forth the objects of that journal, which is claimed to be the only European periodical dealing exclusively with the subject of its title.

"The *Electrician* Annual Tables of Electricity Undertakings, 1923." (140 pp.) London: Benn Bros, Ltd. Price 10s. net.—In this, the 36th edition, the form of presentation adopted in the last two editions has been retained. The information has been brought up to date as far as possible and new undertakings have been added. One feature is a complete list of the supply voltages in Chile.

Circular No. 78 of the U.S. Bureau of Standards, "Solders for Aluminium" (14 pp.). Washington: Government Printing Office. Price 5 cents.—This publication, which is illustrated with photo-micrographs, deals with the following aspects of aluminium solders: application and adhesion; strength and ductility: electrolytic behaviour; and composition. A bibliography of the subject is appended.

"Experimental Electrical Engineering," by V. Karapetoff. Vol. I. Third edition. Pp. xxxii+795; figs. 390. London: Chapman & Hall, Ltd. Price 30s. net.

"Pattern Making," by E. M. McCracken & C. H. Sampson. Pp. 120; figs. 30. London: Scott, Greenwood & Son. Price 10s. 6d. net.

"*Transactions* of the Institution of Engineers, Australia." Vol. I, 1920. Sydney, N.S.W.: The Institution.

Social.—In connection with the annual profit-sharing scheme a social evening and concert was given on Saturday last, to the staff and employés of Messrs. Horace Green and Co., Ltd., in the Cononley National School. About 200 were present. Tea was provided in the afternoon, followed by a concert. In a brief speech, Mr. Horace Green outlined the aims of the profit-sharing scheme, which was inaugurated in 1914, and also the arrangement whereby employés might profitably invest their savings in the business. The evening concluded with a whist drive and dance.

British Trade-Mark Applications.—The following are included among the recent applications for British trade marks. Objections may be lodged within one month from the dates mentioned. In the case of foreign applications the names and addresses of the British representatives are also given:

Weldrines. No. 434,214. Class 13. Electrodes for welding purposes and electrical fittings. Weldrics (1922), Ltd., Bush Lane House, Bush Lane, Cannon Street, London, E.C. May 2nd, 1923.

Armorduct. No. 41,357. Class 8. Electric cables. Magic Appliances, Ltd., 159, Westminster Bridge Road, London, S.E. May 2nd, 1923.

Galco. No. 434,102. Class 8. Wireless coils and electrical instruments. R. J. Galloway & Son, 6, Sydney Road, Richmond, S.W. May 2nd, 1923.

Maxigraph. No. 434,914. Class 8. Electric measuring, registering, and recording instruments. Landis & Gyr Gesellschaft, Zug, Switzerland. (Henry Fairweather, 30-32, Ludgate Hill, London, E.C.). May 2nd, 1923.

Maxigram. No. 434,915. Class 8. Electric measuring, registering and recording instruments. Landis & Gyr Gesellschaft, Zug, Switzerland. (Henry Fairbrother, 30-32, Ludgate gate Hill, London, E.C.). May 2nd 1923.

American Beauty. No. 430,758. Class 13. Electric heating utensils. American Electric Heater Co., Burroughs Avenue, Detroit, Mich., U.S.A. (Marks & Clerk, 57-58, Lincoln's Inn Fields, London, W.C.). May 2nd, 1923.

American Railway Electrification.—The Westinghouse Electric & Manufacturing Co., of Pittsburgh, has just entered into a contract with the Virginian Railway Co. for the complete electrification of the line between Mullens and Roake in the State of Virginia) comprising 134 route miles and 215 miles of track. This line will handle a very heavy coal traffic with 6,000-ton trains up about a 2 per cent. grade and 9,000-ton trains over the rest of the line. The contract includes the

supply of 600-ton, split-phase, 25-cycle, 11,000-volt locomotives. The total contract, including a 50,000-kW power house, amounts to $15,000,000.

Local Exhibition.—Leeds Radio Show.—A radio exhibition on a large scale was opened at the Leeds Y.M.C.A. last Friday by Alderman C. H. Wilson, chairman of the Corporation Finance and General Purposes Committee. The exhibits included many by local trade agents, and special interest was shown in the small crystal sets. Professor R. Whiddington, of Leeds University, lectured on "The How and Why of Wireless," and conducted receiving and transmitting experiments. A feature of the exhibition was a display of "antique" instruments and parts—used in 1906, and others used in trench warfare in 1916.

Chinese Notes.—The wireless telegraph stations at Mukden, Harbin, Changchun, and Tsitsihar have been installed, and operation has been successfully commenced.

A site has been laid out at Nan Ho Yen, inside the Tung An Men, for building a power station for the Peking Tramways. Construction work has been started on the buildings, which are expected to be completed in May next.

The Ta Yu Li Electric Co. at Hangchow has petitioned the Civil Governor of Chekiang for permission to construct tramways in all parts of the city. Registration at the Ministry of Agriculture and Commerce has been also applied for by the company.

A shareholders' meeting of the Pootung Electric Co. in Pootung, Shanghai, was held to discuss questions with regard to the development of the company. At present about 7,000 lamps are used by the city, but it will soon have 13,000 lamps.

The I Tsung Machine Co., of which Mr. C. C. Nieh is one of the directors, is to be established in Shanghai. It has been registered with the Industrial Department of Kiangsu.

The districts of Chaohsien, Paisiang, Lungping, Lincheng, Kaoyi, and Ningchin have incorporated themselves in an organisation called "The Six District Industrial Association," the object of which is the development of district industries and the promotion of mutual relations.

Exhibition Year.—The following comments quoted from the *Electrical Contractor* for May, where they are printed under the title of "An Excellent Idea," refer to our leading article of March 23rd on "Exhibition Suggestions." We then invited our readers to advance further suggestions for ensuring a continuous success of the Exhibition, and we now repeat our invitation:—"The Electrical Review makes the excellent suggestion that next year's British Empire Exhibition should be made the centre for many electrical and allied gatherings. It is suggested that the Exhibition should be made the centre for the summer meeting of the Institution of Electrical Engineers; the annual convention of the Incorporated Municipal Electrical Association; the annual meetings of the two Tramways Associations; for a meeting or two of the British Electrical and Allied Manufacturers' Association, when members and non-members can discuss trade and industrial matters that lend themselves to public conference; *for meetings of the Electrical Contractors' Association*; and for a London meeting of the British Association for the Advancement of Science, so that members who cannot proceed on the Colonial tour of the year, can have a reunion all the same amid practical scientific demonstrations. The whole notion appears to us to be admirable. For ourselves, we believe that an E.C.A. conference in London, attended by members from all over the country and including our Scottish friends, would be productive of much good—and mirth. The conference might well last three or four days, which would afford ample time for a thorough inspection of the Exhibition and for meetings calculated to consolidate electrical contractors throughout the kingdom. In point of fact, the scheme would work in very well with the E.C.A. British Empire Exhibition scheme, with which we hope to deal in an early issue. Meanwhile, the possibilities of such an E.C.A. reunion in London should have the attention of our membership at large."

Conditions of Contract.—The *Bulletin* of the Federation of British Industries records that the first meeting was held on April 25th of the reconstituted "Contracts" Committee of the Federation. The meeting was well attended, and Mr. T. Biggart, who presided, recounted the activities of the previous Committee—the Government and Public Bodies Contracts Committee. He stated that model clauses had been prepared embracing the fundamental conditions which it was felt should be common to all contracts, and that representations had been made to Government departments for the adoption of clauses on those lines in order to standardise contract conditions. In the course of the discussion it was felt that the "Contracts Committee," while continuing the work of the previous Committee, could be of great assistance to members as an advisory body and to trade associations in representing to purchasers—including Government departments, municipalities, and private buyers—grievances with regard to contract conditions which were felt to be inequitable. Several questions had already been submitted to the Committee for consideration, and of these two of the subjects appeared to be such as the Committee could take up with a view to rendering assistance. One of these, which related to tenders being asked for unspecified quantities, the Committee proceeded to consider forthwith. It was hoped the Committee would serve a useful purpose and that trade associations as well as private members of the Federation would take advantage of its assistance on contract questions generally.

Copper and Lead Prices.—Messrs. F. Smith & Co. report May 9th:—No change in electrolytic copper prices.

Messrs. James & Shakespeare report May 9th:—Copper bars (best selected), sheet and rod, no change; English pig lead, £26, 20s. decrease.

Dutch Manufacturing Company.—The Hazemeijer Electrical Apparatus Co., of Hengelo, reports that the slackness in trade due to the general economic situation and the competition of countries with a depreciated currency, continued in 1922; moreover, the critical condition of the Dutch electrical industry exercised an unfavourable influence on sale prices and most orders were only obtainable at a slight margin of profit, the result being that the turnover in 1922 was less than in the previous year and the final outcome was a loss of 34,000 fl. As a favourable factor, the report mentions the formation of a subsidiary company for the production of signalling apparatus which, it is believed, will contribute towards overcoming the period of depression.

Catalogues Wanted in China.—Mr. Douglas O. Bates, A.M.I.E.E., electrical engineer to the Chinese Government Railways, Peking-Mukden Line, Tongshan, desires to receive catalogues of British manufactures.

List of Firms Recommended by the E.C.A.—In each issue of *The Electrical Contractor* there is published a list of firms which have signed the E.C.A. fair trading clauses and which have been accepted by the Council. Against the name of each firm are some reference figures and letters which indicate the character of the undertaking signed by the firm. The key to these reference numbers and letters is published in our contemporary as follows:—

(1) We do not carry out any electric wiring, nor the fitting or installation of apparatus, nor do we sub-contract such work.

(1*b*) We do not carry out any electric wiring, but we occasionally fit and install apparatus which we supply. We do not sub-contract wiring or installation work.

(1c) We do not carry out any electric wiring, but we occasionally fit and install apparatus which we supply, and we occasionally sub-contract wiring and installation work.

(1*ca*) We confine our sub-contracts to members of the E.C.A.

(1*d*) We do not carry out any electric wiring, nor fit or install any apparatus, but we do occasionally sub-contract such work.

(1*da*) We confine our sub-contracts to members of the E.C.A.

(2) We support the principle that an electrical contractor buying for resale, is entitled to a better price than any purchaser for own use—quantity for quantity—and it is our intention to maintain this principle in operation in our business.

LIGHTING AND POWER NOTES.

Blackpool.—Extension of Supply.—The Electricity Committee is negotiating with the Parish Council of Marton respecting a supply of electricity, for which it is proposed that Marton should pay 20 per cent. above the ordinary tariff at Blackpool. Sanction from the Electricity Commissioners is being awaited by the Electricity Committee for authority to lay h.p. feeder cables to the Lytham-St. Annes boundary.

Bradford.—Loans.—The Electricity Commissioners have sanctioned the borrowing of £5,179 for chimneys in connection with the cooling plant at Valley Road station.

The Finance Advisory Committee has approved of the expenditure of £20,000 for mains.

Canada.—Hydro-Electric Development.—The East Kootenay Power Co. announces that a contract has been let for the driving of a tunnel, and other work, in connection with a large hydro-electric plant on the Kootenay River near Elko. It will cost $250,000 to complete. The tunnel will be 2,000 ft. long, 12 by 14 ft. inside dimensions, and will be driven largely through solid rock.—*Reuter's Trade Service* (Cranbrook, B.C.)

Continental.—Belgium.—The Société des Centrales Electriques de Flandres, of Brussels, reports that the second steam-operated generating set of 6,600-kW capacity has recently been installed, and that preparations are being made for the addition of a third set of the same capacity, which will bring the total capacity of the station at Langerbrugge up to 24,000 kW.

Italy.—The Società Anonima Filut Esercizio Elettrico Susa has been constituted, with a capital of 1,000,000 lire, for the construction of a power station at Susa.

Russia.—The difficulty in providing fuel and its high cost and inferior quality have prompted the Board of Communal Undertakings to contemplate the use of the power of the River Desenki in order to generate electricity for Kieff.

Turkey.—According to the report of the Société Ottomane d'Electricité, of Constantinople, for the past year, a new set of 10,000-kW capacity was added to the generating station in November last, while an order has been placed for another set of similar capacity, to be ready for next winter. The output of the plant last year reached a total of 31,696,000 kWh, an increase of 2,500,000 kWh over 1921.

Cranbrook.—Electricity Supply.—The Rural Council has consented to an application by Major B. J. Day, of Hawkhurst, and Lieut.-Col. C. B. Bartley, of Goudhurst, to the Electricity Commissioners for a Special Order to supply electricity in the district. It is proposed to erect a power station at Cranbrook and to distribute electricity by means of overhead wires.

Darwen.—Year's Working.—The report on the work of the electricity undertaking for the past year shows a net surplus of £5,759 against a profit of £4,098 for the previous year.

Derby.—Electricity Supply.—The Town Council has decided to lay new mains in certain parts of the town at an estimated cost of £2,700.

Dover.—Hire of Cooking Apparatus.—The Town Council has decided to expend £250 on the purchase of electric ovens, to be let out on hire.

Gillingham.—Extension of Time.—The Town Council has applied to the Electricity Commissioners for an extension for two years of the time allowed for the temporary increase of electricity charges under the Statutory Undertakings (Temporary Increases of Charges) Act, 1918.

Hove.—Electricity Scheme.—At a recent meeting of the Town Council, the Electricity Committee reported that the Brighton Corporation had intimated that, owing to the increased demand for electricity at Aldrington, it would be impossible for it to continue the supply to that district on the present system, and that it was intended to terminate the present agreement at the expiration of 12 months, which would enable the Hove Town Council to prepare a scheme for taking over the supply.

In connection with the Town Council's proposal to obtain a bulk supply of electricity, the Electricity Committee has been negotiating with the trustees of the Vallance estate for the purchase of land for the erection of a sub-station, &c., at a cost of £5,000. Messrs. Kennedy and Donkin have submitted a report on the proposed sub-station, the cost of which is estimated at £38,035, including the purchase of a site. The electrical engineer (Mr. C. B. Smith) stated that it was proposed to dispose of the plant at the Leighton Road works, which he valued at £20,000. Application is to be made to the Electricity Commissioners for sanction to a loan to carry out the scheme.

Liverpool.—Loan.—The Tramways Committee has recommended that application be made for sanction to borrow £10,000 for the provision of a new 1,500-kW rotary converter, switchgear, &c., at Marsh Lane power station, Bootle.

Electricity District Inquiry.—Owing to counsel and other persons concerned in the Mersey and West Lancashire Electricity District Inquiry having to attend before a Parliamentary Committee in London on May 15th and 16th, the Electricity Commissioners have postponed the local inquiry which was to have been opened on May 15th; it will be commenced at the Town Hall, Liverpool, at 10.30 a.m. on Thursday, May 17th.

London.—St. Marylebone.—The Electricity Commissioners have sanctioned the borrowing of £292,367 for extensions of the electricity works, including new generating plant and a cooling tower.

Luton.—Electricity Supply.—The Town Council has appointed a deputation to confer with the Dunstable, Leighton Buzzard, and Linslade Councils on the question of supplying electricity to these districts.

Manchester.—Loan Sanctioned.—The Electricity Committee has received sanction from the Electricity Commissioners to borrow £20,000 for sub-station buildings.

Marsden.—Inquiry.—The Electricity Commissioners are holding an inquiry on May 23rd at the Town Hall, Huddersfield, into the applications of the Huddersfield Corporation and the Electrical Distribution of Yorkshire, Ltd., for a Special Order to supply electricity in the district.

Milnthorpe (Westmorland).—Electricity Supply.—A meeting of ratepayers was held recently to consider an electric lighting scheme for the district. Mr. T. Wilkinson, electrical engineer, of Arnside, who submitted the scheme, was requested to prepare estimates with a view to the adoption of the scheme.

Newcastle (Staffs.).—New Plant.—In order to meet the increased demand for electricity during next winter, the Town Council has decided to install a 500-kVA converter set, with switchgear, at a cost of £3,000.

Price Reductions.—Reductions in the charges for electricity have been made in the following districts:—

Rawtenstall.—Lighting: First 100 kWh per quarter, 7d. per kWh; next 100 kWh per quarter, 6½d. per kWh; all energy in excess of this amount, 6½d. per kWh. Power: Small consumers: First 500 kWh per month, 2½d. per kWh; next 500 kWh per month, 2d. per kWh; next 500 kWh, 1½d. per kWh; for all additional energy, 1d. per kWh. Large consumers: First 10,000 kWh per month, 1d. per kWh; next 10,000 kWh, .95d. per kWh; next 30,000 kWh, .90d. per kWh; all power in excess of this amount, .85d. per kWh.

Stoke-on-Trent.—Lighting: A reduction of 10 per cent. Power and heating: A reduction of 20 per cent.

Stretford.—Lighting: From 6½d. to 6d. per kWh. Heating and cooking: From 1d. per kWh, plus 85 per cent., to 1d. per kWh, plus 65 per cent.

Walton-on-Naze—Lighting: From 1s. to 9d. per kWh.

Reigate.—Extension of Supply.—The Town Council has received from the Electricity Commissioners an intimation that they will be prepared to entertain an application by the Corporation to supply electricity to Horley and district, provided statutory powers for a bulk supply of electricity to the Council is previously obtained by the parties with whom the Corporation is in negotiation.

Saffron Walden.—Special Order.—The Corporation has applied to the Electricity Commissioners for a Special Order authorising it to supply electricity in the borough.

Southport.—Electricity Supply.—The Brush Electrical Engineering Co. is now fitting new auxiliary oil pumps at the electricity works, and it is expected shortly to commence the fitting of the steam ejectors to replace the Edwards air pumps. The new underground sub-station in London Square is being equipped, and the transfer of the load from the old sub-station to the new one will shortly take place. The electrical engineer reports that the coal consumed per unit generated for the year ended March 31st, 1923, was 2.95 lb. as against 4.03 lb. during the previous 12 months.

Tunbridge Wells.—New Plant.—At a recent meeting of the Town Council, the Lighting Committee recommended that, having considered a report of the engineer as to the proposed extensions to the electricity works, the cost of which is estimated at £56,943, the matter be referred to a consulting engineer for consideration and report. The recommendation was adopted.

United States.—Detroit.—The Municipal Council has decided to issue bonds for a total sum of $12,000,000 in order to complete the new municipal power plant and transmission system. The city uses electricity in all of its departments, and the annual consumption, including that of the street railways, is 200 million kWh. The generating plant is to consist of four 20,000-kW turbo-generators, and power will be transmitted at 24,000 V to a number of transforming-distributing stations.

Hydro-Electric Development.—The Southern California Edison Co. has in hand a scheme for utilising the rivers of the High Sierra Mountains in Central California for generating electricity. It is intended to develop a total of 1,407,000 h.p. at a cost of $375,000,000. Work on the erection of the fourth power station has commenced. The initial plant of the station will consist of three 35,000-h.p. turbine sets, which will ultimately be doubled. 220,000-V outdoor switchgear is to be installed. The company has set aside $26,000,000 for hydro-electric development during 1923.

West Wilts.—Objections to Electricity Scheme.—A number of local authorities are opposing the scheme put forward by the Western Electric Distributing Corporation, Ltd., for the supply of electricity over a large part of the county.

The County Council has decided to apply for an opposing Order. Resolutions of protest have also been passed by the Trowbridge, Melksham, Chippenham, Devizes, and Calne Town Councils. The last Council has already applied for an Electricity Order for the borough and surrounding districts.

Workington.—Electricity Supply.—The Development Committee of the Town Council has recommended that the proprietors of the St. Helen's Colliery be requested to give terms for a supply of electricity to the borough. The Town Clerk has been instructed to write to the Electricity Commissioners and ascertain whether it is their intention to set up an electricity area including West Cumberland, and, if not, what attitude the Commissioners would take towards a joint application of the local authorities in the area.

TRAMWAY AND RAILWAY NOTES

Cardiff.—New Cars.—The Tramways Committee has recommended the purchase of 25 top-covered tramcars at a cost of £43,350 to replace old cars.

Continental.—Italy.—A company under the style of the Società Anonima Ferrovia Elettrica dell'Alta Val di Sole has been formed in Milan with a capital of 220,000 lire for the construction and working of an electric railway from Malé to Fucine.

Sweden.—Concerning the projected conversion to electric traction of the main line between Stockholm and Gothenburg, it is announced that both the State Railway and Telegraph Administrations recommend the execution of the work. It now rests with the new Government to give a final decision on the subject.

Croydon.—Railless Cars.—The Borough Council proposes to introduce railless cars on the Addiscombe route, and has instructed the tramway manager to prepare a report on the scheme.

Darwen.—Year's Working.—The annual accounts of the tramway undertaking for the past year show a profit of £2,944, as compared with a loss of £201 in the previous year.

London.—L.C.C. Tramways.—The annual accounts of the working of the tramways for the year 1921-22 show a total income of £5,160,320. Working expenses amounted to £4,386,891, leaving a gross profit of £773,429. After deducting half the cost of renewals, a credit balance was carried to net revenue account of £570,581. The remaining half-cost of renewals has been charged to capital account. The provision for debt charges, income tax, interest, &c., left a deficiency for the year of £88,757, as compared with a loss of £590,579 in the previous year.

Accident.—Two L.C.C. tramcars collided in Vauxhall Bridge Road on May 4th and delayed the traffic for a considerable time. A number of passengers received minor injuries.

Middleton.—Proposed Purchase of Undertaking.—The Middleton and Rochdale Town Councils and the Chadderton Urban District Council have appointed a joint committee to consider a proposal to purchase the tramway undertaking of the Middleton Electric Traction Co., whose lease expires this year.

Railway Electrification.—S.E. & C. Section.—The electrification of the suburban lines of the South-Eastern & Chatham section of the Southern Railway will be begun within a fortnight, and will cost about £5,500,000. There are about 200 miles of line, exclusive of the sidings, to be dealt with.—*Daily Mail.*

The first contract has been placed for the supply of conductor rails. Originally it was proposed to install the three-wire d.c. system at 1,500 volts. The amalgamation with the other companies has made necessary new plans, and the system will in its essential factors be similar to that of the L. and S.W. Railway, the 600-volt d.c. conductor-rail system. Rolling stock on the S.E. and L. & S.W. railways will be interchangeable, and there will be a sub-station about every five miles over the electrified lines. Power will be supplied by the London Electric Supply Corporation. The scheme has been divided into two sections. The one to be completed first has a route mileage of 94 and a single line mileage, including sidings, of 210. It includes: The Bexley Heath line, Dartford loop line, main line to Orpington, Bromley North branch, Mid-Kent and Hayes branch, main line to Bickley and Orpington, Crystal Palace and Greenwich Park branches, and the Catford loop. The second part of the scheme will follow immediately. It will deal with the Gillingham, Tonbridge, Redhill, Dorking, and several other branches, covering 140 route miles, or 438 miles of single lines and sidings.

The rolling stock will mainly be converted from the existing coaches. For suburban passengers the coaches will be of the motor-cab type, but eventually through passenger and goods trains will be hauled by electric locomotives. The change will, it is estimated, increase the speed and the frequency of the services in the suburban areas by 30 per cent. Farther out speed will be improved by 40 per cent., and frequency of service by 60 per cent.—*Evening News.*

Rotherham.—Extension of Railless Car System.—The Town Council has had under consideration a proposal to extend the tramway system at Maltby, but has decided not to carry out the extensions owing to the high cost. It has been decided, however, to extend the railless car system for a distance of about 1¼ miles.

Sunderland.—New Routes.—The Tramways Committee proposes to extend the tramway service to Silksworth, to join the Sunderland District Tramways, and from Seaburn to Whitburn.

United States.—Railway Electrification.—According to *Electric Traction*, an electric railway is proposed for Arizona, Colorado, New Mexico, and California. The total length of the main line and branches will be 1,307 miles and the estimated capital cost of construction is $76,024,236. The locomotives for heavy freight service will weigh approximately 300 tons each. These locomotives will be in two sections, and operated from either end. The sections may be separated and the single sections used to handle part of the local goods service. The passenger locomotives will weigh 190 tons. Two power stations will be erected, one at Peaceland (New Mexico), with an initial capacity of 62,500 kW, and the other near the Gulf Junction (California), with an initial capacity of 32,000 kW. Provision will be made for future additions to the plant. High-voltage transmission will be introduced and duplicate transmission lines will be erected to ensure continuity of service. Sub-stations will also be erected at various points along the route. Application has been made to the Interstate Commerce Commission for sanction to carry out the scheme.

TELEGRAPH & TELEPHONE NOTES.

The Telephone Service.—New Kiosks.—It is proposed by the Post Office that further telephone call office facilities should be provided in positions readily available for public use. The L.C.C. and other municipal authorities have been asked to co-operate with the Department by affording facilities for the placing of kiosks.—*The Times.*

India.—New Delhi Telephone Installation.—It is expected that the work of laying the cables for the telephones in the new Delhi will be undertaken shortly. The work involves 60 miles of cable. The exchange at the new Delhi will be designed for a maximum capacity of 3,000 subscribers on and up to the date of the automatic system being installed. The estimates at first provide for only 1,500 subscribers. Eventually it is intended to create a similar exchange for Delhi itself, comprising the present civil lines.—*The Times.*

Atlantic Cables.—Rate Reductions.—Cable rates, *via* Imperial, to British West Indies, Bermuda, the Bahamas, and *via* Imperial-Bermuda to British Guiana, have been reduced.—*Evening News.*

RADIO-TELEGRAPHY AND TELEPHONY.

Radio Broadcasting.—Leeds Relay Station.—It is expected that the British Broadcasting Co., Ltd., will open a relay broadcasting station at Leeds this month.

Birmingham Station.—According to the *Birmingham Post*, 5 I T is to be moved from its present home at the Witton G.E.C. works to the Summer Lane generating station of the Corporation Electricity Department. The new transmitting station will be in operation in about six weeks' time; the aerial will be fixed between two of the chimneys, but the studio will be somewhere in the centre of the city.

New Licences.—The Advisory Committee of Post Office officials has examined a large number of the applications for experimental broadcast licences, and has divided the applicants into two classes, namely, actual experimenters and those who wish to listen-in. Experimental licences will be issued to the first category at once, says the *Daily Express*, and will not be held up pending the report of the Committee of Inquiry.

France.—German Radio Patents.—Under the terms of Article 306 of the Versailles Treaty, the French Government has assumed the working of the German Meissner patent in France, by granting licences, &c. The patent is of first importance in the technique of radio telegraphy, and the rights to work it hitherto granted to German nominees in France have, by the Government's action, become null and void.

The Dutch Indies.—Radio Communication.—The Dutch Telegraph Administration announces that radio communication between Holland and the Dutch East Indies is now available during a limited period of the 24 hours. The service is provisionally restricted to telegrams emanating from and destined for the two countries in question.

United States.—Broadcasting.—Major-General Squiers, of the United States Signal Corps, is organising a company to broadcast over high-pressure service wires of electric light and power companies. Concerts, addresses, and bed-time stories will be neatly delivered, if his plans are realised, through a special instrument and paid for on a meter like the gas bill.—*National Electric Light Association Bulletin.*

Unauthorised Possession of Radio Apparatus.—At the Belfast Summons Court on May 3rd, before Mr. Roche, R.M., Mr. John W. Milan, of the Belfast District Committee of the Electrical Trades Union, was summoned, as reported last week, on a charge of being in unlawful possession of apparatus capable of being used for sending or tapping wireless messages. Evidence for the prosecution showed that a visit was made by the police to the defendant's offices on March 24th, where the apparatus referred to was found. It was not "assembled" at the time. The defendant said that he had made the apparatus himself, and that he had applied for an experimental licence, which had been refused. The defendant pleaded not guilty. When his place was visited he made it clear to the police that he had applied for a licence for experimental purposes, so that he might instruct members of his union in the science. At no time was he in possession of apparatus either capable of, or intended for, receiving or tapping wireless messages.

Mr. Roche (to the police witness): Did you examine this apparatus?—I did not examine it, except in a casual way.

The Prosecuting Officer: There is no suggestion that it was a transmitting set.

Mr. Roche: You have to prove that this was intended for, or capable of, being used for sending or tapping messages.

The witness says he did not examine this apparatus.

The police witness maintained that when the apparatus was assembled it would be capable of tapping messages. He said that Mr. Milan declared so himself at the time his place was visited, and he also said that he did not need an aerial, but that the electric lighting installation was sufficient.

The case was dismissed, Mr. Roche remarking: "We cannot waste time over this."

ELECTRICITY SUPPLY AT LEEDS.

Some Recent Extensions.

In May, 1893, the Yorkshire House-to-House Electricity Co., Ltd., commenced to supply electricity in Leeds and district; five years later the City of Leeds Corporation acquired the company's system, and in 1914 it also purchased that of the Roundhay and District Electric Lighting Co., Ltd. The municipal undertaking has power to supply certain specified premises outside its prescribed area (Wharfedale Rural District), and its system is interconnected with that of the Morley Corporation.

For years the undertaking may be said to have been in a continuous state of extension. Under the direction of Mr. C. Nelson Hefford, who has been solely responsible for the design and execution of the whole of the work since his appointment as chief engineer in 1913, new buildings have been added to the old station, which house an extensive meter testing and repairing department, stores, workshops, &c., in addition to accommodating the administrative and engineering staffs. The new edifice, as well as the power house, is served by electric lifts, and a handsome committee room, board room, and an extensive show room have been provided.

The system of supply is high pressure, alternating, one-, two- and three-phase at 50 cycles per second; no d.c. is generated, an a.c. bulk supply being furnished to the tramway undertaking which carries out its own conversion. The generated pressures are 2,000 volts two-phase and 6,600 volts three-phase, the consumers' voltages being 200, 346, and 400. The distributing mains consist of paper-insulated cable in asphalt composition, and one of the most interesting features of the undertaking is the mains records department, which is said to be unique in this country; the system of record

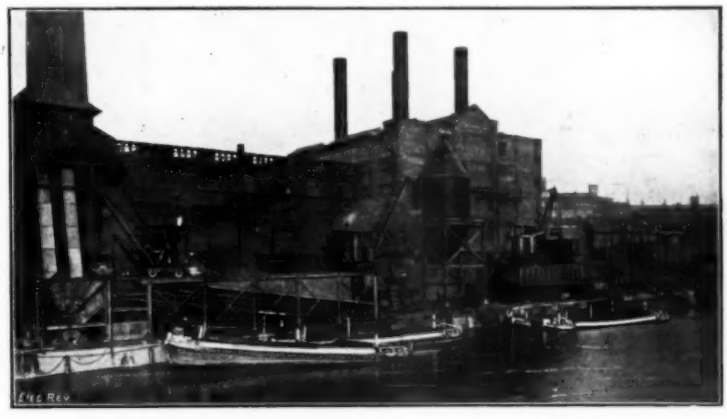


Fig. 1.—Exterior of Leeds Electricity Works.

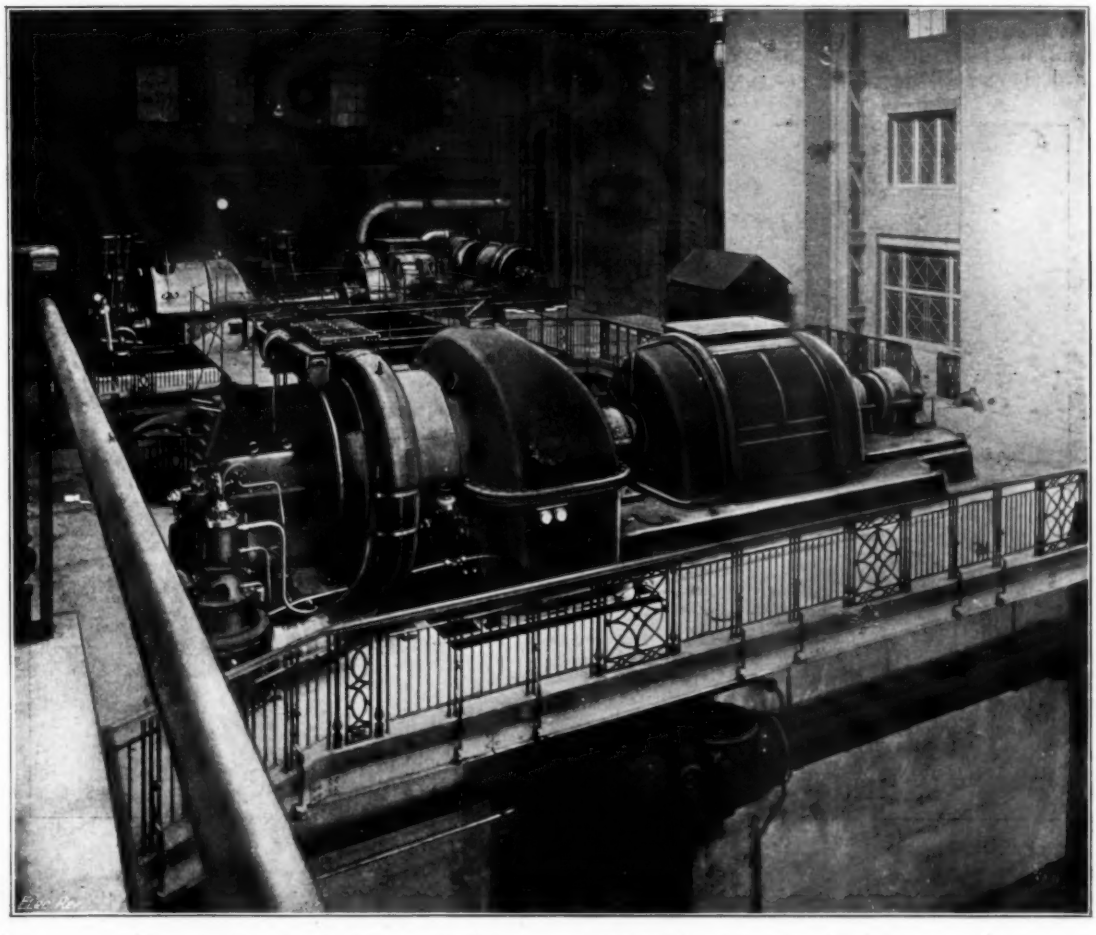
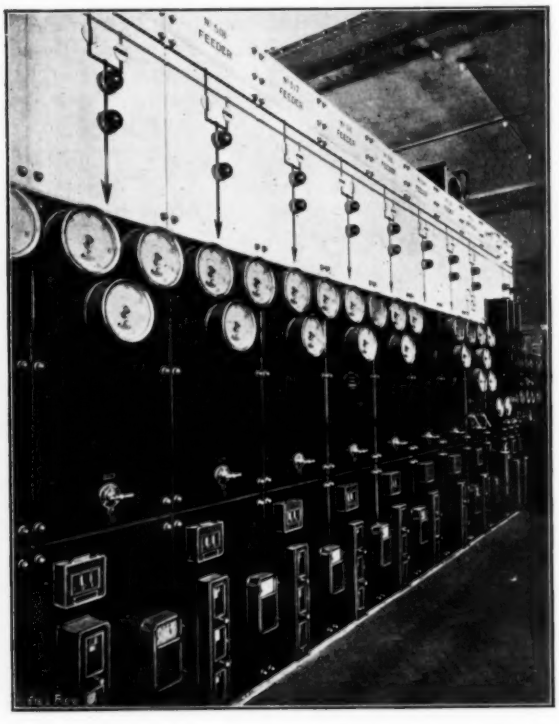
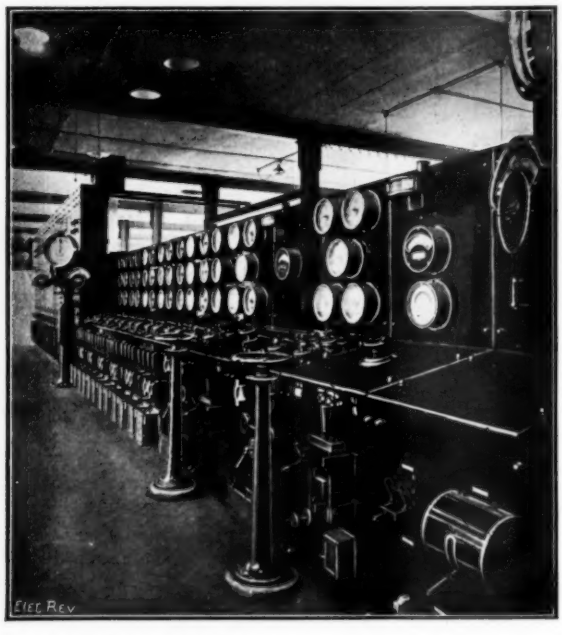


Fig. 2.—New Turbo-generator Room, showing 12,000-kW B.T.-H. Set in Foreground.

keeping has proved of great value during the extension period, and we know of nothing approaching it—it is well worth detailed study.

Some idea of the size of the undertaking is conveyed by the fact that there are some 250 static sub-stations





Figs. 3 and 4.—Main Extra-high-pressure Control Boards.

scattered over its area of supply; they are mostly underground, but in future wherever possible they are to be erected above ground. There are also nearly a dozen Scott-connected sub-stations that serve to convert from two- to three-phase where necessary.

Fig. 11 is a reproduction of the plan of the whole of the generating station, which at present contains plant aggregating 51,000 kW with a 12,000-kW set in course of erection. In the new portion of the station, with which we are chiefly concerned, there is room for a further large set with the requisite switchgear, after the installation of which some of the older sets will have to be replaced with larger plant.

All the coal consumed is delivered by the Corporation's own fleet of barges, some of which are driven by internal-combustion engines; it is discharged by grab cranes (figs. 1 and 8) into tanks where it is weighed by Avery recorders and then delivered by two bucket conveyors to the overhead bunkers, which in the old section of the boiler house have a capacity of about 2,600 tons and in the new section 2,500 tons, each conveyor being

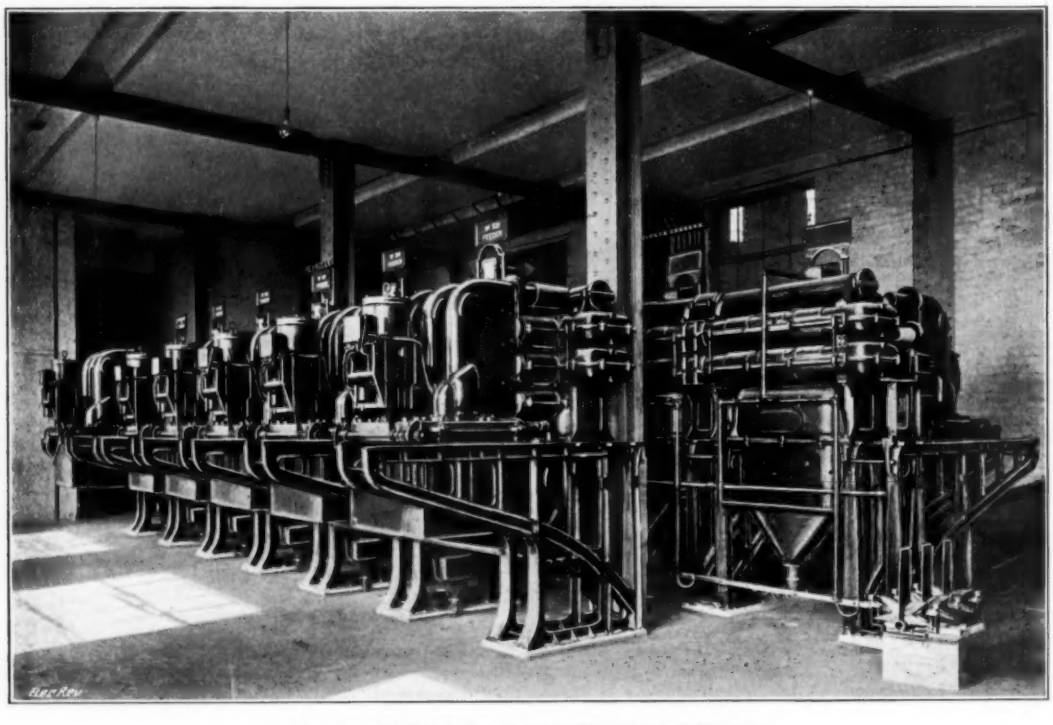


Fig. 5.—Reyrolle Extra-high-pressure Switchgear.

capable of transporting 60 tons of fuel per hour. Fig. 7 is a view of the newer portion of the boiler house, from which it will be seen that the four largest boilers have three grates each, whereas the eight others have two each; there is room for the addition of two more large units. Altogether 36 boilers with superheaters and Green

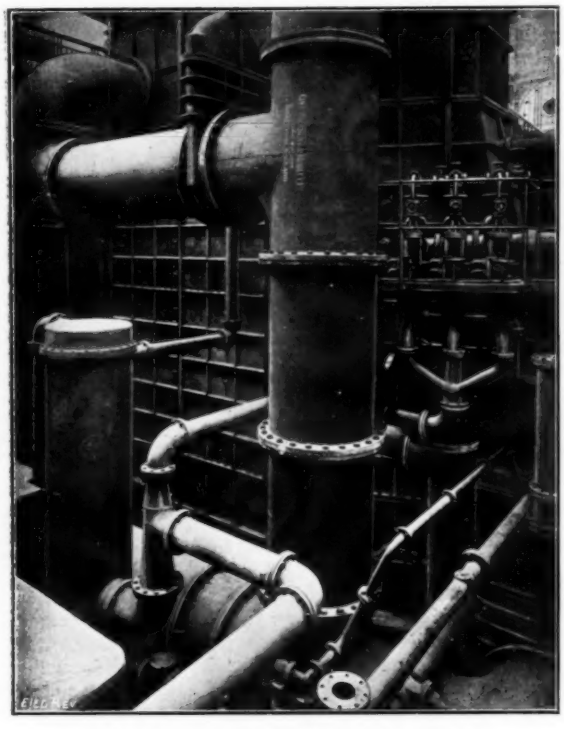


Fig. 6.—C., M. & M. Vertical Condenser.

economisers totalling 6,780 tubes are installed, namely, 12 of 15,000 lb., 12 of 20,000 lb., and eight of 30,000 lb. actual evaporative capacity of the Babcock and Wilcox land type, and four B. & W. c.t.m. 50,000-lb. units. The 24 boilers serving the older portion of the station have one brick chimney in common, whilst eight of those

Fig. 7.—A Portion of the Boiler House.

serving the three-phase sets have one steel chimney per pair, and the remainder one each. There are 42 B. & W. and 24 Bennis chain grates.

The induced draught fans for the older boilers are by Messrs. Matthews & Yates and Musgrave, driven by E.C.C. motors, the newer fans being of the Hattersley Pickard type, driven by Hinchliffe-Green motors. The new boilers are arranged to operate under balanced draught, if required; "W.R." CO_2 indicators and two Venturi and two Lea recorders keep track of the performance of the boiler plant. The B.T.H. turbines driving the auxiliary plant in connection with the two 12,000-kW turbo-generators also drive the boiler feed pumps by means of one shaft; the remainder of the feed pumps are of the Rees Roturbo motor-driven type, two spares being provided. No expansion troubles have been experienced with the steam ring main.

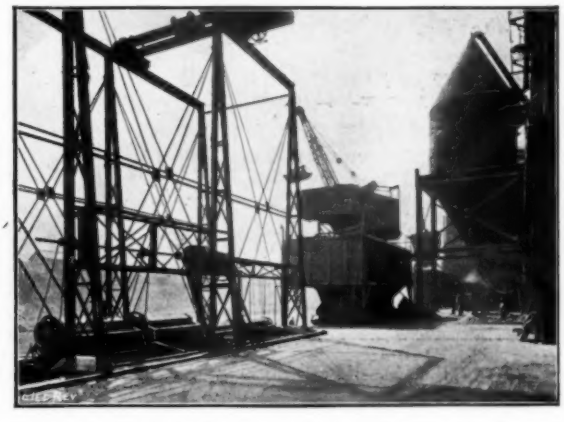


Fig. 8.—Circulating Water Screens.

The ash-handling plant is of the B. & W. suction type, one of the two 120-h.p. motor-driven sets being shown in fig. 9. The ash is discharged from each boiler into a motor-driven crusher that travels on rails round the boiler-house basement. The crushed ash is conveyed into a single receiver, capable of holding 70 tons, shown in figs. 1 and 8, from which it is removed by a fleet of G.E.V. and Electromobile electric vehicles and some Mann and Yorkshire Wagon Co. steam lorries.

The new turbo-generator room is spanned by a J. Isles electric travelling crane provided with two hooks that are capable of lifting 10 and 60 tons respectively.

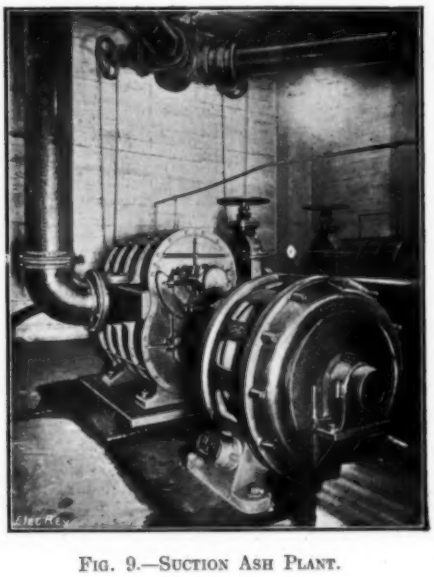


Fig. 9.—Suction Ash Plant.

A total of eight generating sets are in commission, excluding the set in course of erection. The older plant consists of two 7,500-kW and two 3,000-kW two-phase Willans-Dick, Kerr sets; the never machines are as

follows:—Two 6,000-kW Richardsons, Westgarth-Vickers sets, one 6,000-kW B.T.H. set, one 12,000-kW Escher Wyss-Siemens set, and one 12,000-kW B.T.H. set, which is not yet in commission, the last three sets being shown in fig. 2. They operate at a speed of 1,500 r.p.m., three-phase, 50 cycles, 6,600 volts, with a 29-in. vacuum, a steam pressure of 185 lb. per sq. in. superheated 150 deg. F., and a power factor of 0.8. The machines are protected on the Merz-Price system, and the feeders by overload and leakage trip devices; the voltage regulation in both the old and new portions of the station is effected automatically by the Taylor-Scotson method, the raising or lowering of the pressure being controlled by the exciter windings.

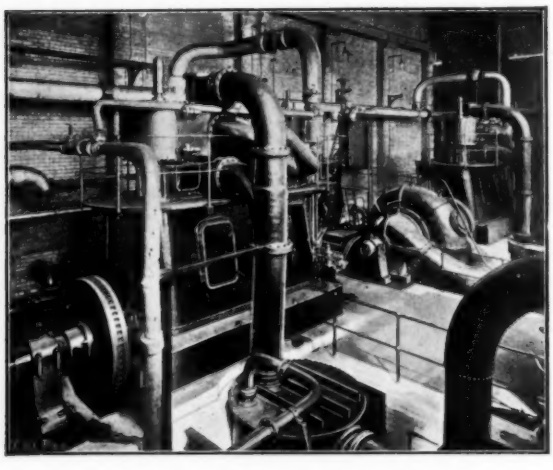


Fig. 10.—New Steam-driven Pumps.

The cooling air for the generators is taken from outside the building, the duct entrances being protected with gauze, and is passed through wet filters; those serving the Richardsons, Westgarth-Vickers and Escher-Wyss-Siemens sets are of the Sturtevant type, while the remainder are by Messrs. Heenan & Froude, except that for the large B.T.H. set now in course of erection, which is of the Grice pattern.

The turbines in the older part of the station have Mirrlees Watson condensers, some of which are of the jet type. Of the newer machines, the 6,000-kW B.T.H. set shown in fig. 2 has a Cole, Marchent & Morley jet condensing plant; the 12,000-kW Siemens-Escher Wyss, a Mirrlees Watson surface condensing plant, and the 12,000-kW B.T.H. set, a Cole, Marchent & Morley surface condensing plant fitted with Delas air ejectors. This set is shown in fig. 6, and as this portion of the plant has already been fully described in our issues of October 21st, 1921, p. 551, and August 18th, 1922, p. 248, it will suffice to mention that each condenser is capable of dealing with 220,000 lb. of steam per hour, maintaining a vacuum of 28.5 in. with the barometer at 30 in. and a cooling water temperature of about 65 deg. F. Some idea of the size of the condenser is conveyed by the fact that the cooling surface has an area of 46,000 sq. ft., the quantity of water required being 2,400,000 gal. per hour. The overall dimensions of the condenser, including pipework, are 58 ft. from back to front, 35.5 ft. high, and 46 ft. from side to side; the exhaust opening is 12 ft. high and 6 ft. wide, the water outlet is 42 in. in diameter, the condenser contains 31 miles of pipes, and its weight with piping, pumps, &c., is 220 tons.

One of the two extraction multi-impeller centrifugal pumps, together with a multi-stage rotary boiler feed pump, is driven by an auxiliary 102-b.h.p., 2,500-r.p.m. turbine; the other pump is coupled direct to an electric motor. The feature of the Delas steam jet air extractor is that 85 per cent. of the heat in the steam operating it is recovered by heating the water for boiler-feed purposes; both the auxiliary turbine and the Delas extractors exhaust into a feed-water heater of the surface type, having a cast-iron casing and $\frac{3}{4}$-in. diameter 18 S.W.G. solid-drawn brass tubes, which is situated beside the condenser.

The condenser circulating water is pumped from the river Aire into a bus pipe arranged so that any pump or condenser can be shut down without affecting the remainder of the plant. The new pumping plant is shown in fig. 10; two Rees Roturbo pumps are driven by old 1,000-h.p. vertical Belliss steam reciprocating engines, which were originally used to drive electric generators. The pumps are capable of delivering 3,400,000 gal. of water per hour, the intake pipe being 60 in. in diameter and the water being returned to the river by a concrete culvert. The screens are shown in fig. 8; they are of the rotary type, and were specially constructed by Messrs. F. W. Brackett & Co., Ltd.

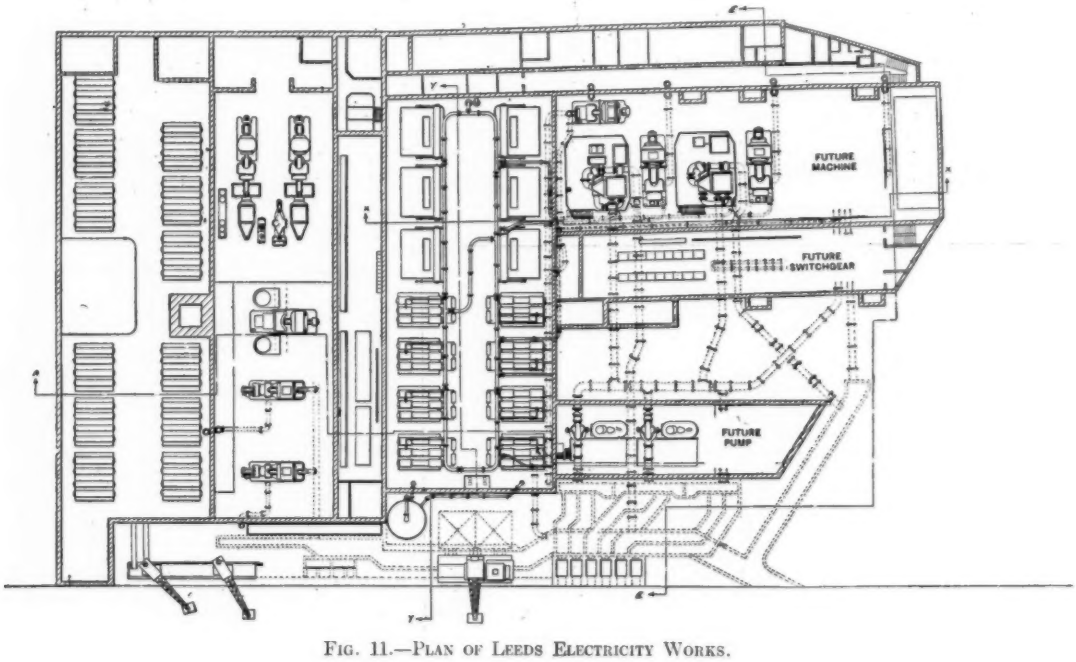


Fig. 11.—Plan of Leeds Electricity Works.

The switchgear controlling the old two-phase portion

of the station is of the Ferranti type. The more modern gear is of the (Westinghouse) Metropolitan-Vickers e.h.p. cellular pattern, whilst the latest addition to the switchgear is shown in fig. 5; this was supplied by Messrs. A. Reyrolle & Co., Ltd. Figs. 3 and 4 show the main station control boards.

In concluding this necessarily brief description of an interesting station, mention may be made of the fact that the maximum load recorded was 36,400 kW, the total connections on the system being 109,583 kW. The number of power consumers is now 3,412, with a total capacity of motors of 73,596 kW; the number of users of electric light is 21,992, the capacity of the installations being 22,452 kW. The use of electricity for heating purposes continues to increase in the district, the number of such consumers being 3,392, and the capacity of their apparatus 8,669 kW. A high percentage of increase is also shown by "residential bulk supplies," which represents the sale of energy to private residences at the flat rate of ½d. per kWh, plus a fixed quarterly charge based on the rateable value of the premises. The number of such consumers is now 1,301, their total capacity being 4,700 kW.

Finally, we have to express our thanks to Mr. C. Nelson Hefford, manager of the undertaking, and to Mr. E. Porter, his chief assistant engineer, for the courtesy with which we were received on the occasion of our visit to Leeds, and for their assistance in compiling this article.

TRAMWAYS AND LIGHT RAILWAYS IN 1921-22.

The Ministry of Transport has published a mass of statistical details relating to the road tramways, light railways, and railless trolley undertakings in Great Britain.* In the case of publicly-owned systems the particulars are made up as far as March 31st, 1922; in the case of company undertakings as far as December 31st, 1921.

During the period dealt with the total capital expenditure upon undertakings increased by £4,036,247 to £85,908,610 (local authorities, £65,086,138; companies, £20,822,742).

The total gross receipts were £32,523,339, as compared with £32,692,209 in 1920-21, and the total working expenditure amounted to £26,835,292, as against £28,339,706, making the net receipts £5,688,047, or £1,335,444 more than in the previous year. The balance between receipts from rates and aid afforded to rates remained unfavourable at £196,565; in 1913-14 the net contribution to rate relief was £515,419.

The net income available for distribution amounted to £6,744,779, and of this sum £2,216,489 was appropriated for interest charges and dividend, £1,657,508 for repayment of debt, and £1,524,591 for reserve and renewal funds. The available balance in 1920-21 was smaller, but all the charges with the exceptions of income tax and "other purposes" were also lower, enabling a larger sum to be carried forward.

It is to be noted that the ratio of working expenses to receipts fell from 86.44 to 82.51 per cent., although this still compared unfavourably with the 1913-14 ratio of 64.51 per cent.

At the end of the period there were 250 tramway undertakings in Great Britain, 170 of which were owned by local authorities. Three undertakings were closed down and two absorbed, while two were added. The total route-mileage open for traffic was 2,579 miles (local authorities, 1,756); this represented an increase of three miles only. The mode of traction was predominantly electric, other forms accounting for about 2 per cent.

The number of passengers carried during the year was 4,256,268,692, a decrease of 413,647,712. The car-mileage decreased from 345,153,585 to 332,079,865. Of this total electric traction represented 98.24 per cent. As compared with 1913-14 the number of passengers carried increased by 28.90 per cent., although the car-mileage showed a decrease of 2.02 per cent.

The quantity of electrical energy used decreased by 31,407,240 kWh to 593,621,200. The amount consumed per car-mile fell from 1.85 to 1.82 kWh.

Twenty-eight local authorities possessed powers to work railless traction, but only nine of these actually carried passengers. Stockport Corporation abandoned the system; Halifax Corporation, however, made up for this by commencing to work its system. A total of 9,879,730 passengers were carried, a decrease of 755,697; the car-mileage increased from 1,276,504 to 1,374,444. The total route-mileage in operation was 47, and the energy consumption averaged 1.29 kWh per car-mile.

Tables are included in the return which give full details of the capital authorised, paid up, and expended, both for companies and local authorities; others give particulars of the year's results expressed both in actual figures and per car-mile. The last is probably of the greatest value as showing the wide limits between which receipts and expenses may fluctuate.

As regards municipal undertakings, that of the Morecambe Corporation earned a revenue of 32.31d. per car-mile, whereas the Kilmarnock system received 15.52d. In each case, however, the working expenses were commensurate to a certain degree with the revenue, being 27.09d. and 17.44d. respectively per car-mile. The working expenses of the Barking undertaking were the highest—48.61d. per car-mile, with a revenue of 17.96d. At the other end of the scale was the Stalybridge, Hyde, Mossley, and Dukinfield joint undertaking, whose working expenses amounted to 14.24d. against a revenue of 17.11d. per car-mile. The best ratio between working expenses and receipts was that of the Southport undertaking, 63.58 per cent.; the ratio for Barking was 166 per cent.

Among the company undertakings the receipts and expenses per car-mile of the Great Orme undertaking were 116.5d. and 111.3d. respectively. Apart from this, which is out of the ordinary, the undertaking with the highest revenue was that of the Great Eastern Railway Co. at Wisbech and Upwell (44.17d.); the lowest was that of the Taunton company (9.5d.). The highest and lowest working expenses were incurred by the Lancaster & District undertaking (79d. per car-mile), and the Aberdeen Suburban system (10d.). The lowest ratio of working expenses to receipts was that of the Birmingham District tramways (48.0 per cent.); the highest was that of the Lancaster & District system (336 per cent.).

The statistics for the railless systems show that the Aberdare system earned the highest revenue (20.54d.), and the Bradford system the lowest (13.83d.). As regards working expenses, these were: highest, Keighley (33.51d.); lowest, York (11.6d.). The best expenses-to-receipts ratio was that of York (67 per cent.), and the highest that of Keighley (161.74 per cent.).

* "Tramways and Light Railways (Street and Road), and Trackless Trolley Undertakings." H.M. Stationery Office. Price 15s. net.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Argentina.—Buenos Aires.—June 4th. Department of Navigation and Ports. Machine tools, electric motors, pumps, electric battery trucks, ceiling, wall, and table fans.*

Ashton-under-Lyne.—May 14th. Town Council. Electric light installation, town yard buildings and hospital. Borough electrical engineer.

Australia.—Melbourne.—August 31st. Victorian Electricity Commission. 500 miles of .0707 sq. in. aluminium steel-cored cable.

July 31st. Electrically-operated power shovel. (April 20th.)

August 25th. 31 22,000-V transformers ranging from 750 to 15 kVA.—*Reuter's Trade Service* (Melbourne).

June 5th. City Council. 6,600-V switchgear for sub-stations.

Brisbane.—June 5th. Public Works Department. Three motor-driven pumps.

October 31st. City Electric Light Co. One 12,500-kW turbo-alternator unit at Bulima, Brisbane.

Sydney.—June 21st. Postmaster-General's Department. Telephone switchboard wire and switchboard and multiple twin underground cable.*

June 11th. City Council. 10,000-V earthing reactance and resistances.*

Basingstoke.—May 24th. Board of Guardians. Wiring and fittings for electric lighting installation at the Institution. (See this issue.)

Belfast.—May 22nd. Electricity Department. Switchgear for sub-station and transformers. (May 4th.)

Belgium.—May 16th. The Société Nationale des Chemins de Fer Vicinaux, 14, Rue de la Science, Brussels. Overhead equipment for the Dieghem-Haecht section of the Brussels-Haecht local railway. Particulars (5 fr.) from the Service Electrique, 48, Rue Montoyer, Brussels.

Bradford.—June 7th. Electricity Department. One 15,000/20,000-kW turbo-generator, &c. (without condensing plant). (April 27th.)

Crook.—June 4th. Urban District Council. Pole line, transformers, and switchgear in connection with the electric lighting scheme. (See this issue.)

Darlington.—May 18th. Electricity Department. Cooling tower. (May 4th.)

Dover.—May 17th. Electricity Department. One turbo-alternator with auxiliaries, cables, switchgear, converting plant, cooling pond, &c. (May 4th.)

Dublin.—May 14th. Electricity Committee. Steam coal for the electricity works, &c. Tender forms from J. J. Murphy, Town Clerk, Exchange Buildings, Lord Edward Street, Dublin.

May 24th. Great Northern Railway (Ireland). Stores for 6 months, including signalling materials, &c. (See this issue.)

Dundee.—May 18th. Electricity Department. L.p. twin paper-insulated lead-covered armoured cable. (May 4th.)

Eccles.—May 22nd. Electricity Department. 1,300-kVA group of Scott-connected transformers. (See this issue.)

Edinburgh.—May 15th. Electricity Supply Department. Underground insulated cables for 12 months. (April 27th.)

India.—ALLAHABAD.—July 3rd. Public Health Department. Pumping plant, consisting of oil engines, generators and motors and centrifugal pumps at Fyzabad in connection with the water supply scheme. Executive engineer of the Second Division of the Public Health Department, Allahabad.

Limerick.—May 21st. Electricity Department. Three Diesel oil engines, direct coupled to three d.c. generators. (See this issue.)

London.—PADDINGTON.—May 14th. G.W. Railway Co. Stores for 6 months, including telegraph instruments, electrical apparatus, wires and cables, &c. (April 27th.)

INDIA STORE DEPOT.—May 18th. Electric cables. (May 4th.)

ST. PANCRAS.—May 17th. Electricity Department. E.h.p. switchgear. (May 4th.)

METROPOLITAN ASYLUMS BOARD.—May 23rd. Installation of electric lighting in the administrative block, engineers' office block and isolation ward block at the North-Western Fever Hospital, Lawn Road, Hampstead, N.W. (May 4th.)

ISLINGTON.—May 30th. Electricity Department. Plant for raising water from artesian well by compressed air lift, water-treating plant, h.p. and l.p. switchgear for sub-stations. (See this issue.)

Manchester.—May 29th. Electricity Committee. Twelve months' supply of cable. (May 4th.)

May 14th. Tramways Committee. Drilling machine. Mr. H. Mattinson, general manager, Corporation Tramways, 55, Piccadilly, Manchester.

New Zealand.—WELLINGTON.—June 26th. Public Works Department. Switchgear for the Waikato power house.

NAPIER.—Borough Council. One 500-kVA generator and exciter set. Hay, Vickerman & Lancaster, Ltd., Wellington, N.Z.*

DUNEDIN.—May 28th. City Council. Storage battery and distribution transformers.*

July 16th. Switchboard panels.*

Plymouth.—May 15th. Electricity Department. Two water-tube boilers, with economisers. (May 4th.)

Poole.—May 28th. Town Council. Electrical installation, waterworks pumping station, Corfe Mullen. Mr. A. P. I. Cotterell, engineer, 17, Old Queen Street, Westminster, London, S.W.1.

Rumania. — June 1st. The Department of Overseas Trade is informed that a Rumanian municipality intends to place an order for one 600-h.p. Diesel engine and dynamo (220 V, d.c.), including cost of installation.*

Salisbury.—May 17th. Town Council. Wiring and fitting part of the Council house for electric lighting. City engineer and surveyor.

St. Johnston (Co. Donegal).—June 1st. Installation of an electric lighting plant in the church. Rev. D. Watson, St. Johnston.

Uruguay.—MONTEVIDEO.—June 12th. State Electric Light Works. 42,000 metal-filament electric lamps.*

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

CLOSED.

Australia. — SYDNEY. — Electricity Committee. Recommended:—

Reactor for 17,500-kW turbo-alternator (£1,046).—Australian General Electric Co.

H.p. cables (£13,850).—W. T. Henley's Telegraph Works Co., Ltd.—*Tenders.*

MELBOURNE.—Electric Supply Committee.

Four 500-kVA transformers (£1,840).—Siemens Bros. & Co., Ltd.—*Tenders.*

Ballinasloe.

Electric lighting installation at Garbally Court.—Messrs. Roche and Magenis, Dublin.

Blackpool.—Electricity Committee. Recommended:—

1,250-kW geared turbine.—Messrs. Fraser & Chalmers, Ltd.

Bradford.—Tramways Committee.

800 tons steel girder rails (£11 15s. per ton).—Dorman, Long & Co., Ltd.

20 tons steel fishplates (£15 10s. per ton).—Bolckow, Vaughan & Co., Ltd.

Fee for inspection and supervision of manufacture of silicon steel rails (3s. per ton).—C. P. Sandberg.

12 pairs "Hadura" points (£112 10s. per pair), and 24 manganese steel crossings (£28 15s. each).—Hadfields, Ltd.

Supply of welding portions.—Thermit, Ltd.

Buxton (Derbyshire).—Town Council. Accepted:—

Supply and erection of a 780-amp.-hour battery at the municipal electricity works.—D.P. Battery Co.

Supply of automatic reversible boosters and switchgear.—The Electric Construction Co.

Canterbury.—Town Council. Accepted:—

Electric wiring and fittings at the Cookery School and for wiring the electricity works.—G. Dashwood.

Dover.

Electrical installations at the extensions of Messrs. Vyse & Son, Ltd.—J. L. Etheridge & Co.

Edinburgh.—Some discussion took place at the Town Council meeting on May 3rd regarding electrical tenders received from two British firms. Approval of a recommendation of the Electricity Committee to accept the offer of Messrs. Bruce Peebles & Co., Edinburgh, for the supply of two 800-b.h.p. induction motors for the Leith station, at £3,250, was proposed. It was also moved that the offer of the English Electric Co., Ltd., at £3,110, be accepted. In support of this, it was argued that both machines were excellent, and that, as there was no question of quality, price should rule. It was stated that the original tender by Messrs. Bruce Peebles amounted to £3,550, and after the Committee had agreed by a majority to recommend acceptance of the tender at that figure, the firm reduced it to £3,250. One speaker contended that if local firms could not give tenders within reasonable distance of the others, then they should receive no preference, while another member held that the recommendation was unfair to the English Electric Co., which was entitled by all the rules of fairplay to get the contract after making a special effort to put in a low tender. The proposal to accept the English Electric Co.'s tender was carried by 25 votes to 18.

London.—L.C.C. Highways Committee.

	Pipework.	Feed Pump.
	£	£
British Electric Plant Co., Ltd.	—	959
Worthington-Simpson, Ltd.	—	**963**
J. Wolstenholme & Son, Ltd.	2,343	—
Aiton & Co., Ltd.	**2,505**	—
W. H. Allen, Sons & Co., Ltd.	—	1,125
Babcock & Wilcox, Ltd.	2,677	1,150
Rees Roturbo Manufacturing Co., Ltd. ...	—	1,234
John Spencer, Ltd.	2,729	1,444
Gwynne's Engineering Co., Ltd	—	1,560
Brightside Foundry and Engineering Co., Ltd.	2,758	2,110
Stewarts & Lloyds, Ltd.	2,812	—
Latona Engineering Co., Ltd.	3,012	—

With the concurrence of the General Purposes Committee, the Committee has accepted the tenders of Aiton & Co., Ltd., for the pipework, and Worthington-Simpson, Ltd., for the feed pump.

METROPOLITAN ASYLUMS BOARD. Works Committee. Recommended:—

Installation of electric lighting at the Grove Hospital.

S. Reed & Sons (recommended)	**£1,476**
Higginbotham & Sons	1,480
T. Clarke & Co., Ltd.	1,484
Myall Bros.	1,497
Perfecto Electrical Co.	1,716
W. P. Young & Co.	1,761
E. B. Haselden	1,923
A. Dean & Co., Ltd.	1,941
D. Henderson	1,950
A. V. Gilkins & Co., Ltd.	2,116
Guild Housing, Ltd.	2,137
"Ohms," Ltd.	2,216
J. C. Christie	2,240
G. Sparrow & Co.	2,250
G. H. Turner & Co., Ltd.	2,250
Brightside Foundry and Engineering Co., Ltd.	2,275
Toy & Winslow	2,275
M. Partridge & Co.	2,535
National Electric Construction Co., Ltd.	2,772

ST. MARYLEBONE.—Highways Committee.

Two 50-kW motor-generator sets, complete with switchgear (£788).—City Electrical Co. (Recommended.)

Electricity Committee.—The Committee has again carefully considered the tenders received for the supply of underground cables, the Council having referred back the recommendation that the tender of the British Insulated & Helsby Cables, Ltd., be accepted. (See ELEC. REV., March 23rd, p. 460, and April 20th, p. 621.)

Inquiries have been made of 14 of the largest municipal electricity undertakings in London and the provinces as to the experience they have had with cables manufactured and supplied by firms whose tenders were lower than the tender recommended by the Committee. After close consideration, the Committee again advises the Council to accept the tender of the British Insulated & Helsby Cables, Ltd., for the supply of cables during the municipal year ending March, 1924.

60-ton electric travelling jib crane and gantry (£5,530).—Babcock & Wilcox, Ltd. (Recommended.)

Closed-circuit air cooler for the 12,500-kW turbo-alternator (£1,275).—General Electric Co., Ltd.

Malvern.—Urban Council. Accepted:—

Water-softening plant for the electricity works.—Scott & Western.

North Lancashire.

Electric lighting installation at Witherslack Hall (Lord Derby's).—Gilbert Gilkes & Co., Ltd.

FORTHCOMING EVENTS.

Royal Society of Arts.—Monday, May 14th. At John Street, Adelphi, W.C. At 8 p.m. Howard Lecture, "The Development of the Steam Turbine," by Mr. S. S. Cook. (Lecture III.)

Wednesday, May 16th. At John Street, Adelphi, W.C. At 8 p.m. Paper on "Industrial Lighting and the Prevention of Accidents," by Mr. L. Gaster.

Institute of Transport (Graduates' and Students' Section).—Tuesday, May 15th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 5.30 p.m. Paper on "The Design and Maintenance of Commercial Motor Vehicles," by Mr. G. J. Shave.

Institution of Railway Signal Engineers.—Wednesday, May 16th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 6.30 p.m. Paper on "Signal Apparatus for Use in Foggy Weather and Snow," by Mr. W. Challis.

Chemical Society.—Thursday, May 17th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary scientific meeting.

Mersey and West Lancashire Electricity District Local Inquiry.—Thursday, May 17th. At the Town Hall, Liverpool. At 10.30 a.m.

Royal Institution of Great Britain.—Thursday, May 17th. At Albemarle Street, W. At 3 p.m. Lecture on "Engineering Problems Solved by Photo-elastic Methods," by Prof. E. G. Coker, F.R.S. (Lecture I.)

Friday, May 18th. At 9 p.m. Lecture, "Recent Studies in Alternating Magnetism," by Mr. W. M. Mordey.

Roentgen Society and the Electro-Therapeutic Section of the Royal Society of Medicine.—First annual joint meeting, Thursday, May 17th. At the Royal Society of Medicine, Wimpole Street. At 5.30 p.m. Mackenzie Davidson Memorial Lecture, by Mr. A. W. George. Dinner at 8 p.m. At the Langham Hotel.

Electrical Power Engineers' Association (Southern Division).—Friday, May 18th. At the Institution of Electrical Engineers. At 7 p.m. Lecture on "Combustion of Fuel," by Mr. C. Erith.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

WE have to remind readers that Service Department inquiries should be accompanied by a stamped addressed envelope.

The makers or suppliers of the following devices are asked for:—

WY-VEE cable connectors.
GRAY'S patent heater.

NOTES.

A Commutator Slotter.—ERRATUM.—In our issue of April 27th, in our "New Devices" Column, we fell into error by publishing, as a novel invention, a description of a commutator slotter made by an American firm. Messrs. Oerlikon, Ltd., point out that the design is practically identical with that company's "Republican" undercutter, and have sent the following letter to the *Electric Railway Journal*, from which we culled the note:—

"The ELECTRICAL REVIEW makes reference in the issue of the 27th April to a description which apparently appeared in the columns of your valued paper in connection with above. It is stated that the Martindale Electric Company, of Cleveland, Ohio, has put on the market the 'Imperial Undercutter.' May we suggest that it would be better described as the 'Republican Undercutter' in so far as it was produced fully 20 years ago by the Ateliers de Construction Oerlikon, Oerlikon, near Zurich, Switzerland. It has been made use of during quite two decades by the leading British municipal and tramway undertakings. It is fully described in the enclosed leaflet.

"The apparatus has, ever since its invention, experienced practically no alterations, and it is to-day as much admired and used as ever."

Appointments Vacant.—Plumber-jointer, for the Wigan Corporation electricity department; foreman for laying and jointing l.p. cables (94s.) for the Stoke Newington B.C. Electricity Department. (See our advertisement pages to-day.)

The National Association of Supervising Electricians.—On Tuesday last, the reading of short papers in a competition for the shield presented by the President, Mr. W. E. Highfield, took place at St. Bride's Institute.

The President opened the proceedings with a review of the conditions of the competition, and the reading of twelve papers was carried out by others than the authors. The competitors were allowed to take as their subject any aspect of the electrical industry or the Association, and it is remarkable that there was no overlapping of papers, even in the four that touched upon matters connected with the N.A.S.E. Mr. A. H. Dykes, M.I.E.E., was present, and decided the order of reading by the drawing of numbers which concealed the identity of the authors.

The first paper was a reasoned advocacy of the use of c.t.s. cable for internal wiring. This was followed by a criticism of the Association which fell under two main heads:—(*a*) The meagre attendance at the meetings, and (*b*) the lack of force in the agreement between the Association and the N.F.E.A. The author gave reasons, and suggested remedies, for the first matter, and suggested with regard to the second criticism that the executive should approach employers who had not put the agreement into force, and not leave it to the members themselves, thereby prejudicing their positions.

This paper, which proved to be the winner of the shield and the first prize—a crystal radio set, presented by the Cable Accessories Co., Ltd.—was by Mr. E. E. Gammon. The next paper dealt with the relation of the N.A.S.E. with the rest of the electrical industry, and urged the drawing-up of a salary schedule, and the aiding of apprentices, and this was followed by a thesis on "Trade Unionism" which stressed the importance of the educational side of employés' organisations. The fifth paper, which eventually secured the third prize, described in a practical manner the distribution of electricity on board a modern battleship. This was written by Mr. J. Southern. "Mutual Help" was the title of the ensuing paper, which advocated closer co-operation between the engineer in charge of work and the foreman. The seventh paper treated of modern lightning conductors, and gave an able review of the phenomena of lightning.

The titles of the next two papers were: "The Future of the Industry"—which forecast an eventual saturation of the market, prophesied a bright future for electric power and cooking, but indicated that electric heating would be retarded by conservatism; and "Power Factor Improvement," in which the author pointed out the advantages of static condensers. The next paper, by Mr. R. W. J. Stark, took the second award. It was an able discourse, naturally condensed, upon the modern electro-chemical industry, and dealt with the production of aluminium, nitrogen, phosphorus, and many other commodities.

The penultimate paper considered the position of the N.A.S.E. as a trade union, and urged members to afford the Association better support, and thus maintain their status. The final contribution was intended to aid members who were experiencing a change-over from d.c. to a.c., and described the various types of a.c. motors in brief detail.

At the conclusion of the readings the President voiced the feeling of the members present in remarking upon the difficulty of selecting the best of such a good collection of papers, and Mr. A. H. Dykes, who presented the prizes to the successful authors, spoke to the same effect.

The second prize (valued at two guineas) was given by Major T. Vincent Smith, and the third (value one guinea) by Mr. Dykes.

British Science Guild.—A deputation from the British Science Guild, consisting of Lord Askwith, K.C.B. (President of the Guild), Lord Avebury, Mr. Hunter Gray, K.C. (chairman of the Guild's "Inventions and Patents" Committee), Sir Robert Hadfield, Bart., F.R.S., Sir Trevor Dawson, Bart., Sir Richard Gregory, D.Sc., Mr. A. A. Campbell Swinton, F.R.S., and Lt.-Col. W. O'Meara, C.M.G. (hon. secretary of the Guild), waited upon Lt.-Col. A. Buckley, D.S.O. (Parliamentary Secretary to the Department of Overseas Trade), with whom was Mr. W. Temple Franks, C.B. (Comptroller-General of Patents) at the House of Commons on May 1st.

The deputation, which was introduced by Lord Askwith, strongly urged that the necessary steps should be taken as early as possible by the Government to secure effect being given to the provisional scheme for an Empire Patent drawn up at the British Empire Patent Conference held in London in June last year. The scheme in question provides that a patent issued anywhere within the British Empire shall extend to the United Kingdom, or to any of the self-governing Dominions, or to India, upon registration in the particular territory in which protection is desired. (See Stationery Office publication, "Report of the Conference held at the Patent Office, London, from June 12th, 1922, to June 23rd, 1922.")

The proposals of the deputation were sympathetically received by Colonel Buckley.

Educational.—IMPERIAL COLLEGE OF SCIENCE.—Sir Henry Birchenough, Sir Donald MacAlister, and Sir Otto Beit, whose term of office as governors was to have expired on June 1st, have been reappointed for a further term of four years.

POLYTECHNIC, REGENT STREET, W., ELECTRICAL ENGINEERING DEPARTMENT.—A special course of lectures will be given during the summer term on Mondays by Mr. P. Kemp, the Head of the Department, on "Power Factor and its Improvement"; on Tuesdays, on "Protection of E.H.T. Systems," by Mr. H. P. Young; on Wednesdays, on the "Thermionic Tube and its Application in Wireless Circuits," by Mr. W. H. Date; and on Thursdays, on "Some Aspects of Electrical Engineering Economics," by Mr. D. J. Bolton. The first meeting is on May 28th, and the fee for each course is 7s. 6d. (For further particulars see our advertisement pages to-day.)

Birmingham Electrical Golfing Society.—During 1922 three meetings of this Society were held, and three cups played for. The first was won at Copt Heath on May 29th by Mr. E. L. Ball, the second at Little Aston on July 17th by Mr. J. H. Berry, and the third at Walmley on October 17th by Mr. W. L. Topple. The spring meeting will be held at the Robin Hood Golf Club next Monday afternoon, May 14th, when the challenge cup presented by the electrical trade will be up for competition. Golfers in the electrical trade in the Midlands are eligible, and can enter up to the time of the competition, namely, 2 o'clock on Monday next. The summer meeting will be held in July, and the autumn meeting towards the end of September. The address of Mr. W. A. Millinger, the honorary secretary, is 9, Livery Street, Birmingham.

The Illumination of the "Coliseum" Tower.—The electrically-illuminated "revolving" sphere surmounting the "Coliseum," St. Martin's Lane, W.C., has been for a long time a familiar sight, but the beautiful effect obtained by illuminating the contour of the tower is of very recent date. This is the first example to be seen in this country of a system which has been employed in Paris for some time—the use of long tubes containing neon gas, which is made to glow by the application of high electrical pressure. The installation was carried out by Messrs. Girdlestone & Co. under the supervision of Mr. J. R. Bedford, M.I.E.E., a member of the firm, and we were recently permitted to inspect it. The tower possesses a certain amount of architectural beauty, and the neon tube system does not detract from its appearance during the day, as long lines of small electric lamps might. The glass tubes are 30 mm. in diameter and are bent to the shape of

Neon-Tube Illumination of the "Coliseum" Tower.

the arches and other main lines of the structure, and although when illuminated they appear as a broad band of light of the distinctive orange colour given by neon, during the day they are hardly perceptible. In the ends of the tubes are fixed cylindrical copper electrodes separated by glass fillets from the tubes themselves. The pressure of the gas in the tubes is about 1/70th of atmospheric pressure. The tubes are connected in series in thirteen distinct groups, each with its transformer. The fixing is carried out on teak with iron clips. As the supply in the district is 200 V d.c. it has been necessary to install a 25-kW rotary converter, which produces 50-cycle, a.c at 150 V. The supply from this is taken through sna switches and choking coils, by wire-armoured cables to th step-up transformers, which are mounted in the tower. Her it is transformed to 5,000/5,500 V, and carried by flexible, well-insulated cables to the ends of the tubes. This cable, made by W. T. Henley's Telegraph Works Co., Ltd., was subjected to a 20,000-V spark test without breakdown. All parts of the system are well earthed, both through spark-gaps and "solid." The total load of the installation is only 18 kW; it will, therefore, be readily appreciated that the system is cheap as well as very effective. The tube portion of the system was manufactured in Paris, but arrangements have been made with the French patentees for its production in this country.

Fatalities.—Thomas Collins, a miner, recently climbed to the top of a standard bearing power cables for the Powell Duffryn colliery at Pengam, near Cardiff, and received a fatal shock at 10,000 V.

On May 6th Allan Greensmith, of Sheffield, climbed a pole carrying a cable from Raincliffe to Smithy Wood Colliery. Overbalancing, he clutched at the cable and was immediately killed by a 500-V shock.

Bernard Widdowson (25), of Erdington, a tester at an electrical works, recently died at the Magnet Club of the General Electric Co., Witton, Birmingham. His brother stated at the inquest that Bernard on Saturday played in a cricket match at Kidderminster and was the top scorer. After the match witness and his brother returned to the Magnet Club, where a dance was taking place. Later witness heard that his brother had fallen down the stairs and had died shortly afterwards. Death was due to a fracture of the skull.

Safeguards against Gas Dangers.—To lessen the dangers arising from the use of gas, the General Purposes Committee of the London County Council makes a number of recommendations. The main suggestion is that there should be closer co-operation between the various authorities concerned in the breaking-up of roads which may result in injury to gas mains. It is also recommended that gas undertakers should consider what additional means they can adopt to bring effectively to the notice of consumers the danger arising from escapes of gas and the necessity of reporting at once the existence of leaks. Gas undertakers should be given power to prescribe the size and material of internal piping, to inspect the piping and appliances on any consumer's premises, and to refuse a supply to those consumers whose installations are in a dangerous condition, after due warning.

New Niagara Treaty Suggested.—The rapidly-increasing need for more diversion from the Niagara River for the use of the Queenston plant of the Hydro-Electric Power Commission of Ontario is expected to result in stimulating Canada's interest in a new treaty. Two years ago, when the U.S.A. State Department suggested the advisability of discussing the matter of additional diversion, Canadian officials did not encourage the proposal. Since then, however, the situation has changed materially, as there has been steady expansion of the distribution system until it reaches as far westward as Detroit.

The demand for additional diversion is even greater on the American side than in Canada. The Niagara Falls Power Company has been running at full capacity for eight months. By the time that the additional 100,000 h.p., which is the net gain represented by the improvements now under way, is available this autumn, it will be absorbed immediately.—*Power.*

Street Accidents.—According to the annual return of street accidents caused by vehicles during the year 1922 (Stationery Office, 2d. net), 111 fatal and 5,251 non-fatal accidents, out of totals of 2,768 and 67,429 respectively, were due to tramcars. The figures under practically all heads were in excess of those recorded for 1921.

Gift to Hong-Kong University.—The *Birmingham Post* reports that Sir Paul Chater has made a gift of $250,000 (about £29,200 at the present rate of exchange of the Hong-Kong dollar) to the University of Hong-Kong. Sir Paul is a well-know merchant in Hong-Kong.

The Duddell Memorial.—In October, 1920, a committee was formed to collect funds for a Duddell memorial. The committee consisted of Sir W. Bragg, Sir H. Darwin, Sir R. T. Glazebrook, Dr. R. Knox, Prof. T. Mather, Mr. Roger T. Smith, and Mr. R. S. Whipple. In response to the appeal 210 subscribers contributed a total sum of £639 5s. 8d. In addition the Councils of the Physical Society of London and the Röntgen Society subscribed £50 and £10 10s. respectively. The total amount subscribed was, therefore, £699 15s. 8d.

At the request of the committee Mrs. Mary G. Gillick has designed a bronze memorial medal, which is illustrated herewith, and Mr. Emery Walker has prepared a diploma to accompany the medal. The artist has succeeded in showing

The Duddell Memorial Medal.

in a striking manner the apparent youthfulness of Duddell as well as the erectness of his carriage. The obverse of the medal represents the quest of Science for Knowledge, a symbolic figure with a lamp and a globe. The medal will be awarded periodically by the Council of the Physical Society to those who have advanced physical knowledge by the invention or design of scientific instruments, or of materials used in their construction. The interest on £400 (invested in 5 per cent. War Loan Inscribed Stock) will be presented to the recipients of the medal.

The dies from which the medal will be impressed and the scrip of the investment are to be handed by Sir William Bragg to the President of the Physical Society, on behalf of the subscribers to the Memorial Fund, at the meeting to be held to-day at the Imperial College of Science.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Mersey and North Wales (Liverpool) Centre.—The first report of the committee for the 1922-23 session covers the first half of the session as the Liverpool Sub-Centre, and the latter half under the new status. The committee met on eight occasions; the average attendance being 13. Eight ordinary general meetings have been held with an average attendance of 92, excluding the popular lecture on "Broadcasting," when 625 people were present. The discussions have been well maintained, and the number of new speakers taking part shows a marked increase. On December 11th, Mr. F. Gill, the president, addressed the meeting, and on February 19th the Lord Mayor of Liverpool (Mr. F. Wilson) delivered an address. The total membership of the Centre is now 471, an increase of 24 for the year; the total number of members transferred to other districts or whose names have been removed from the list this session is 66. The total expenses for the 1921-22 session amounted to £179.

Students' Section Report.—The committee has held five meetings, the average attendance being seven. Six ordinary general meetings have been held with an average attendance of 26, one open meeting with an attendance of 123, and two informal discussions with attendances of 32 and 12. Six visits to works have been made with an average attendance of 15.

The Faraday Society.—The Society will hold a general discussion on "The Physical Chemistry of the Photographic Process" on May 28th at the Institution of Electrical Engineers. Prof. W. D. Bancroft, of Cornell University, will open the proceedings at 3 p.m. with an introductory address on "The Theory of Photography." This will be followed by detailed consideration of the subject. Between the afternoon and evening sessions a complimentary dinner will be given at the Hotel Cecil to Prof. Bancroft and the other guests.

The Engineering Joint Council.—The constitution and by-laws of the Council were issued on Wednesday. The Council, in the first instance, comprises eight members, two each appointed by the Institutions of Civil, Mechanical and Electrical Engineers, and the Institution of Naval Architects ("Founder Institutions"). The chairman will be elected annually, from each Institution in rotation, the secretary of the same institution acting as secretary for the Council. Incidental expenses will be defrayed by the Institution from which the chairman and secretary have been appointed for the time being. Provision is made for the admission to representation of other institutions of suitable professional standing ("constituent institutions") by one representative from each, and for the reference of questions to the Council by "affiliated institutions," which will not have the right to vote.

Edinburgh Electrical Society.—Mr. J. Walker has been elected chairman of the Society; Mr. A. Whitley, vice-chairman; and Mr. W. S. Johnson, hon. secretary and treasurer.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

The Electricity Committee of the Wimbledon Town Council has recommended the Staffing Committee to increase the salary of the borough electrical engineer, Mr. McKenzie, from £1,000 to £1,250, as from April 1st last, with a further increase to £1,500 on April 1st, 1924, provided that the net profits of the undertaking during the year ending March 1st, 1924, will enable the Council to reduce the charges for lighting purposes to 4½d. per unit, and for cooking and heating to 1d., and also to allocate out of the net profits such a sum as will bring the reserve fund up to £10,000. It is also recommended that when the alterations to the Spearing boilers are completed, Mr. McKenzie be paid £250, and on the completion of the installation of the 3,000-kW turbo-alternator a further sum of £250, and that he be permitted to undertake work as a consulting engineer on agreeing to remain with the Corporation for three years from April 1st, 1923, subject to his right to determine the agreement on three months' notice, if he should obtain an appointment as chief electrical engineer of a station of a capacity of 20,000 kW or upwards.

Torquay Town Council has decided that the borough electrical engineer's salary shall continue to be paid on the A.M.E.E. basis, to be adjusted at the end of the financial year, in accordance with the output of the combined undertaking, the revised salary to be retrospective to April 1st, 1923.

Mr. E. Seymour Wood, M.I.C.E., late of the South Hetton Coal Co., Ltd., has concluded arrangements to actively represent the Harland Engineering Co., Ltd., and the British Electric Plant Co., Ltd., on the East Coast, with headquarters at Newcastle. Mr. Wood has been for 12 years on the Council of the Institution of Mining Electrical Engineers and the North of England Institution of Mining and Mechanical Engineers.

The *Commonwealth Engineer* stated in March that Mr. J. S. Just, general manager of the City Electric Light Co., was sailing for America by the *Manganui*. He was making an extensive tour through America, the United Kingdom, and Europe.

We are pleased to learn that Mr. R. A. Chattock, city electrical engineer of Birmingham, is rapidly recovering from his recent severe attack of influenza, and it is hoped that he will be able to resume his duties in the course of two or three weeks.

On the evening of Thursday, May 3rd, at the Sheffield showroom of the Edison Swan Electric Co., Ltd., the staff made a presentation to the manager, Capt. Stanley Boys, D.S.O., on the occasion of his approaching marriage, which took place on Saturday last at Surbiton.

At the 15th annual dinner of the Bradford Engineering Society last Friday evening, Mr. C. E. Allsopp, A.M.I.E.E., sales manager to the Bradford Corporation Electricity Department, who retired from the presidency of the Society after two years in the chair, was presented with a case of stainless cutlery and an umbrella as an expression of the members' appreciation of his chairmanship. The presentation was made by Mr. J. W. Longley, vice-president. Mr. H. Moss has been elected a member of the Council of the Society for the third time.

Tenders reports that Mr. R. H. Bartley, electrical engineer and tramways manager to the New Plymouth (N.Z) Borough Council has been appointed assistant engineer to the Auckland Electric Power Board.

We are pleased to note that Mr. Thomas Roles, the Bradford City electrical engineer, who has been absent from duty for some months owing to ill-health, has been able to resume his duties.

A presentation of a gold watch, suitably inscribed, has been made by Messrs. Clark, Forde & Taylor, consulting engineers, to Mr. T. H. Tebbett, on his completing 50 years' duties with the firm.

Obituary.—Mr. R. L. McCulloch.—We regret to read in the *Commonwealth Engineer* that Mr. R. L. McCulloch, general manager of the Hobart municipal tramways, died recently. During a period of 18 years he was assistant and acting manager to the Merthyr Electric Traction and Lighting Co., managing engineer to the Leamington and Warwick Electric Light and Tramway undertaking, engineer and manager to the city of Carlisle electric tramways, resident engineer at Bo'ness electricity works, and, during 1920-21, was chief engineer to the North of Scotland Power and Lighting Co., Inverness. Mr. S. H. Hancox, the present tramway engineer, has been appointed to the position of manager and engineer to the undertaking.

Mr. J. T. Osler.—The death is announced at Hampstead, London, after an operation, of Mr. John Taylor Osler, the eldest son of the late Mr. Alfred C. Osler and of Mrs. Osler, Fallowfield, Edgbaston. Mr. Osler, who was 49 years of age, was a director of the firm of Messrs. F. & C. Osler, Ltd., electric fittings makers, Birmingham, and he came to London 20 years ago to direct his firm's activities here.

Wills.—The late Mr. J. T. Jervis, M.Inst.C.E., a director of the Notting Hill Electric Lighting Co., Ltd., left £7,997 gross and £3,825 net personalty.

Dame M. Edith Clifton Robinson, widow of Sir James Clifton Robinson, of electric tramway fame, left £11,648.

NEW COMPANIES REGISTERED.

Basic Power Trust, Ltd. (189,604).—Registered April 28th. Capital, £4,000 in 1s. shares. To adopt an agreement with J. C. Hartley and to carry on the business of dealers in shares, stocks, debentures, debenture stock, and other securities, capitalists, financiers, &c. (The precise significance of the title is not apparent from the "objects.") The first directors are:—J. C. Hartley, Fountain Cottage, Seal Chart, Sevenoaks; F. W. Hallewell, 92, Haynt Walk, Merton Park, S.W.19. Minimum cash subscription, 7 shares. Secretary: F. W. Hallewell. Registered office: 2, Dean's Yard, The Sanctuary, Westminster.

Hall and Brenard, Ltd. (189,696).—Private company. Registered May 2nd. Capital, £1,000 in £1 shares (300 6 per cent. cumulative preference). To adopt an agreement with G. H. L. Hall and R. Brenard, and to carry on the business of wholesale radio and electrical engineers and suppliers carried on by them at 10, Manor Gardens, Purley, Surrey. The first directors are:—R. Brenard, "Wharfedale," Sandy Lane South, Wallington, Surrey; G. H. L. Hall, 10, Manor Gardens, Purley, Surrey. Qualification, £100. Remuneration (except managing director, if any) as fixed by the company. Secretary: G. H. L. Hall.

Piness and Bradlaw, Ltd. (189,708).—Private company. Registered May 2nd. Capital, £3,000 in £1 shares. To take over the business of lamp shade manufacturers carried on as "Piness & Bradlaw." The subscribers (each with 1 share) are:—S. G. Ballard, 5, Holborn, E.C.1, clerk; A. Parker, 5, Holborn, E.C.1, cashier. The first directors are to be appointed by the subscribers. Solicitor: F. P. Woodcock, 5, Holborn, E.C.1.

Defiance Electrical Co., Ltd. (189,625).—Private company. Registered April 30th. Capital, £100 in £1 shares. To carry on the business of exporters, importers, and manufacturers of electrical, gas, oil, and lighting goods, and accessories and wireless insulating appliances, &c. The subscribers (each with one share) are:—T. P. Phillips, "Glan-y-Nant," Dynevor Road, Garnant, manufacturer's agent; D. J. Phillips, 39, Groton Road, Earlsfield, S.W.18, manufacturer. The subscribers are to appoint the first directors. Solicitors: H. Crafter & Co., 35, Bloomsbury Square, W.C.1.

Magnus Volk, Ltd. (189,750).—Private company. Registered May 3rd. Capital, £5,000 in £1 shares. To acquire the undertaking and all or any of the assets and liabilities of Magnus Volk, Ltd. (incorporated in 1901); to adopt an agreement between the said company and R. Carpenter, the liquidator thereof, of the first part, M. Volk of the second part, M. H. Volk of the third part, and this company of the fourth part; to operate the electric railway at or near Brighton. The subscribers (each with one share) are:—M. Volk, 38, Dyke Road, Brighton, electrical engineer; M. H. Volk, 15, Marine Square, Brighton, engineer. The first directors are:—M. Volk (chairman), M. H. Volk, C. J. M. Whittaker, and Anna Volk. Solicitors: J. K. Nye & Donne, 58, Ship Street, Brighton.

Kingsland Engineering Co., Ltd. (189,699).—Private company. Registered May 2nd. Capital, £2,000 in £1 shares. To carry on the business of general electric motor engineers and smiths, manufacturers of woodworking machinery, &c., and to adopt an agreement with W. G. Tagg and R. A. Kendrick. The first directors are:—W. G. Tagg, senr. (permanent governing director and chairman), 45, Cleveland Road, South Woodford, Essex, engineer; W. G. Tagg, junr., 45, Cleveland Road, South Woodford, Essex, furniture manufacturer. Qualification, £5. Remuneration, 10s. 6d. each per meeting. Secretary: W. G. Tagg, junr. Registered office: 106-108, Kingsland Road, E.2.

Headphones (Manchester), Ltd. (189,725).—Private company. Registered May 3rd. Capital, £2,000 in £1 shares. To take over the business of dealers in electrical supplies and accessories carried on by W. Hall and Mary Shaw at Manchester as the "Oxford Electric Co.," and to carry on the same and the business of manufacturers of wireless and other scientific instruments, &c. The permanent directors are:—W. F. Peck, "Beechwood," Anson Road, Victoria Park, Manchester; N. du B. Hennessy, 80, Upper Chorlton Road, Manchester; W. Hall, no address given; Mary Shaw, no address given. Qualification, £100. Remuneration, £250 per annum, divided between them.

Reform Accessories Co., Ltd. (189,645).—Private company. Registered April 30th. Capital, £1,500 in £1 shares. To acquire the business of manufacturers of motor lamps, generators, horns, and electrical goods and accessories carried on at Moseley Street and Bishop Street, Birmingham, as the Reform Accessories Manufacturing Co. The first directors are:—A. T. Izon (managing director), 86, Putney Road, Handsworth, Birmingham; Mrs. Lucy H. Izon, 86, Putney Road, Handsworth, Birmingham; A. W. Izon, no address given. Qualification, 100 shares. Solicitors: Alfred and W. H. Green, 10J, Colmore Row, Birmingham.

A. J. Bennett and Weaver, Ltd. (189,656).—Private company. Registered May 1st. Capital, £10,000 in £1 shares. To adopt an agreement with A. J. Bennett and to carry on the business of mechanical and electrical engineers, instrument makers, manufacturers of motors, &c. The life directors are:—A. J. Bennett, "Rousdon," Crook Log, Bexley Heath; H. G. Weaver, "Glen View," Warren Road, Bexley Heath, with £500 and £300 per annum as remuneration. The remuneration of the said H. G. Weaver may be increased by the board to £400 per annum without the sanction of the company. Qualification, 100 shares. Secretary: H. G. Weaver. Registered office: 28, Broadway, Bexley Heath.

Rissik, Fraser, Spinks & Co., Ltd. (189,646).—Private company. Registered April 30th. Capital, £10,000 in £1 shares. To carry on the business of manufacturers of and wholesale and retail dealers in vulcanite, ebonite, ebonite dust, powdered rubber, and articles in the manufacture of which ebonite, vulcanite, rubber or any substitute therefor is used; electrical and scientific instruments, &c. The first directors are:—J. Mitchell, no address given; F. A. Rissik, 11, Warwick Mansions, Cranwell Crescent, S.W.5; A. Fraser, 34, Torrington Square, Bloomsbury, W.C.; J. Alston, no address given. Remuneration as fixed by the company.

British Nett Battery Co., Ltd. (189,622).—Private company. Registered April 30th. Capital, £2,000 in £1 shares. To acquire the benefit of an invention relating to a portable accumulator known as the "Nett Battery"; to adopt an agreement with C. F. Buffard, and to carry on the business of manufacturers and exporters of and dealers in "Nett" and other batteries, electric cabling, &c. The subscribers (each with 1 share) are:—E. A. Simms, 12, Norfolk Street, Strand, W.C.2, secretary; G. J. Cavendish, 106, Shorndean Street, Catford, S.E., accountant. The first directors are:—J. L. Major, W. A. M. Valon, and S. L. Forbes. Qualification, 100 shares. Solicitors: Kenneth Brown, Baker, Baker, Lennox House, Norfolk Street, Strand, W.C.2.

Light o' Day Electric Lamp Co., Ltd. (189,640).—Private company. Registered April 30th. Capital, £15,000 in 5,000 "A" and 7,000 "B" cumulative participating preference shares of £1 and 60,000 ordinary shares of 1s. To take over the business of applying to electric lamps a lac known as Oriona Lac, carried on by R. Gordon and C. Barclay at 20, Copthall Avenue, E.C. The first directors are:—Sir Charles S. Kirkpatrick, Bart., 9, Ossington Street, Bayswater, W.; H. G. Rowley, Rowley Green, Arkley, near Barnet; G. E. Byers, 51, Hunter Street, W.C.1; J. Keele, "Eastley," Buckhurst Hill; R. Gordon, 71, Holmewood Gardens, Brixton Hill, S.W.2. Qualification, £1 share. Remuneration, £50 each per annum and a percentage of the profits divided between them. Registered office: Walter House, Bedford Street, W.C.

Marchaphone, Ltd. (187,716).—Private company. Registered May 2nd. Capital, £5,000 in £1 shares. To acquire the undertaking and all or any of the assets and liabilities of Gilbert Marchat, and to carry on the business of manufacturers of, and dealers in wireless apparatus, &c. The first directors are:—G. Marchat, 23, Aubrey House, Maida Hill, W.; I. J. Lithauer, 23, Aubrey House, Maida Hill, W. (managing director of Lithauer, Ltd.). Qualification (except first directors), £250. Remuneration, £50 per annum. Registered office: 27, Chancery Lane, W.C.2.

Bussanel Engineers, Ltd. (189,522).—Private company. Registered April 26th. Capital, £1,000 in £1 shares. To carry on the business of electrical and general engineers, manufacturers of wireless apparatus and other electrical accessories, wood workers, cabinet makers, makers of furniture, veneer panel, and wood letter cutters, showcase makers, &c. The life directors are: T. H. Buss, 72, Mannock Road, Wood Green, N.; G. Elston, 231, Harvist Road, Kensal Rise, N.W. (both directors of Buss & Elston, Ltd.). Qualification, £100. Secretary: A. J. Popplewell. Registered office: 2, Northport Street, N.

London Wireless Co., Ltd. (189,415).—Private company. Registered April 21st. Capital, £500 in £1 shares (100 preference and 400 ordinary). To carry on the business of manufacturers of wireless apparatus, &c. The permanent directors are:—Sarah West, 34, Putney Hill, S.W.15; C. A. West, 34, Putney Hill, S.W.15 (both directors of Putney Garage, Ltd.). Qualification, 1 share. Secretary: Sarah West.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Helsby Wireless Telegraph Co., Ltd.—J. B. Edwards, of 7, The Crescent, Bedford, ceased to act as receiver or manager on January 30th, 1923.

Rushmores (1919), Ltd.—Sir Basil E. Mayhew, K.B.E., F.C.A., of Alderman's House, Bishopsgate, E.C.2, ceased to act as receiver or manager on April 16th, 1923.

Brook, Hirst & Co., Ltd.—Satisfaction in full on April 26th, 1923, of debentures dated November 20th, 1907, securing £7,000.

Illuminated Publicity, Ltd.—Debenture dated April 21st, 1923, to secure £100, charged on the company's property, present and future, including uncalled capital. Holder: W. Engelke, "Carlax," Blenheim Road, St. Albans.

Midland Electric Wire Co., Ltd. (104,571).—Return dated April 14th, 1923. Capital, £5,000 in £1 shares. All shares taken up and paid for in full. Mortgages and charges, nil.

Reading Electric Supply Co., Ltd. (35,651).—Return dated April 26th, 1923. Capital, £152,200 in £1 shares. 152,125 shares taken up. £147,775 paid. £4,350 considered as paid. Mortgages and charges, £100,000.

Edwd. Deane & Beal, Ltd. (92,885).—Return dated December 20th, 1922. Capital, £60,000 in 20,000 preference and 40,000 ordinary shares of £1 each. 20,000 preference and 20,009 ordinary shares taken up; £9 paid; £40,000 considered as paid. Mortgages and charges, £12,500.

Crossley Brothers, Ltd. (51,970).—Return dated March 12th, 1923. Capital, £2,000,000 in 403,390 preference and 1,596,610 ordinary shares of £1 each. 403,390 preference and 1,015,414 ordinary shares taken up; £533,200 paid; £885,604 considered as paid. Mortgages and charges, nil.

United Electric Tramways Co. of Caracas, Ltd. (89,642).—Return dated October 30th, 1922 (filed April 24th, 1923). Capital, £500,000 in £1 shares. 170,000 shares taken up; £7 paid; £169,993 considered as paid. Mortgages and charges, £136,000.

Phillips Commutator Grinder Co., Ltd. (74,554).—Return dated January 26th, 1923. Capital, £25,000 in £1 shares. 5,452 shares taken up; £1 per share called up on 3,602 shares; £3,603 3s. paid, including £1 3s. paid on forfeited shares; £1,850 considered as paid on 1,850 shares. Mortgages and charges, £550.

James Scott, Ltd.—Deposit on April 4th, 1923, of deeds of 48, Hedon Road, Hull, to secure £600. Holders: C. H. Thompson and J. Thompson, both of Withernsea.

Spicer & Co., Ltd.—Particulars filed of £5,000 debentures authorised March 9th, 1923, charged on the company's undertaking and property, present and future, including unpaid capital, the whole amount being now issued. Also registered charge on the company's undertaking and property, present and future (subject to above debentures), dated April 12th, 1923, to secure all sums not exceeding £5,000, for which the mortgagees may become liable by virtue of a guarantee by them to company's bankers. Holders: E. R. Jones, 411, Tower Buildings, Liverpool, and others.

Electric Winding and Doubling Co., Ltd.—Particulars filed of £6,000 debentures authorised April 10th, 1923, charged on the company's property, present and future, including uncalled capital, the amount of the present issue being £4,100.

Universal Welding Co., Ltd.—Debenture dated March 27th, 1923, to secure £750, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: E. Walton, 3, Condray Road, Southport, Lancs.

H. Arrowsmith & Co., Ltd.—H. Sharp, of 30, Brown Street, Manchester, was appointed receiver on April 13th, 1923, under powers contained in debenture dated August 9th, 1922.

Van Raden & Co., Ltd.—Satisfaction in full on December 11th, 1922, of mortgage dated October 1st, 1920, securing £1,000.

Trinmph Electric Manufacturing Co., Ltd.—Satisfaction to the extent of £1,000 on April 11th of debenture dated February 19th, 1923, securing £6,000.

Crampton & Co., Ltd. (109,328).—Return dated March 2nd, 1923. Capital, £2,500 in £1 shares. All shares taken up. £2,500 paid. Mortgages and charges, nil.

Nalder Bros. & Thompson, Ltd. (62,214).—Return dated April 4th, 1923. Capital, £30,000 in 15,000 preference and 15,000 ordinary shares of £1 each. 12,000 preference and 11,881 ordinary shares taken up. £13,881 paid. £10,000 considered as paid. Mortgages and charges, nil.

Telegraph Manufacturing Co. (Colonial), Ltd. (71,854).—Return dated April 4th, 1923. Capital, £2,000 in £1 shares. All shares taken up. £2,000 paid. Mortgages and charges, nil.

CITY NOTES.

British Thomson-Houston Co., Ltd.

The annual meeting was held on May 2nd, at the offices, Crown House, Aldwych. Mr. H. C. Levis, chairman, in moving the adoption of the report, said that he thought it would be considered satisfactory in view of trade conditions obtaining throughout the year. The profit for the year enabled them to make proper depreciations, pay the interest on debentures and loans, the dividends on the preference shares, and to recommend the same dividend on the ordinary shares as last year, and carry forward a somewhat larger amount. The volume of orders received during the year was greater than in the preceding year. This increased volume, together with the large amount of unfilled orders on hand at the beginning of the year, brought about the results appearing in the accounts. There had been no increase in the issued capital. There was a slight reduction in the outstanding amount of debentures by reason of the redemptions under the respective trust deeds. In the balance sheet for the previous year, a large amount was shown as owing to the International General Electric Co., but at the last meeting he called attention to the fact that this had been liquidated in full, and there was no further liability in this connection. A comparison between the current liabilities and the liquid assets, showed that the company was in a very strong financial position. The liquid assets were about four times the current liabilities. All of the expenditure on factories shown in the balance sheet amounting to about £300,000, was in connection with extensions authorised prior to the year under review. It would be necessary in the near future to make further additions to some of their factories to provide certain manufacturing facilities which were required. The value of the various factories as

they stood on the balance sheet was very much less than the cost of replacement. Their policy was to keep the buildings and equipment maintained in first-class condition. In the profit and loss account for the previous year there was set aside a reserve for contingencies of £100,000. So far it had not been necessary to encroach on that, and it now appeared on the balance sheet. A general reserve of £50,000 made this year also appeared. The profit for the year, after deducting all expenses and charges other than interest on debentures and loans, was £494,592. To that there had to be added the amount brought forward, £230,704, making the total amount to be dealt with £725,296. From that was deducted £118,614 for interest on debentures and loans; £99,386 for various depreciations; £13,125 had been written off the cost of converting the preference shares, and £50,000 had been set aside for a general reserve. That left to be carried to the balance sheet £444,171. Dividends on the preference shares had been paid up to December 15th last, and the directors now recommended a dividend of 6 per cent., free of income tax, on the ordinary shares, which would absorb £120,000, and leave to be carried forward £236,671. It might be of interest to them to know that the company had now nearly 4,000 preference share and debenture holders in this country. Their participation in the formation of the Power Securities Corporation Ltd. was referred to in the report. The company and three others each subscribed for 100,000 ordinary shares. 500,000 preference shares and 100,000 ordinary shares were offered to the public and the entire amount was taken up. The Corporation had secured the entire share capital of Messrs. Balfour, Beatty and Co., Mr. George Balfour, M.P., becoming the chairman of the Power Securities Corporation, the joint managing directors being Mr. A. H. Beatty and Mr. William Shearer, both having been associated with Messrs. Balfour, Beatty & Co. for a long time. It had commenced active operations, and they had every reason to believe that it would be successful. He hesitated to comment on general business conditions, as the position was somewhat obscure and uncertain. The conditions, however, appeared to be more favourable than they were at the beginning of 1922, and unless something unforeseen occurred he thought they were justified in looking forward to an improvement in trade both at home and abroad, although it might be slow. So far as the electrical industry was concerned, there seemed to be an almost unlimited field for progress, and he thought it was fairly safe to assume that the developments here would relatively approximate what had been done in other countries. In that progress they had every reason to believe that their company would have its full share, and it was well equipped to take advantage of any improvement in business which might occur. The satisfactory results which were shown this year were due in large measure, as in the past, to the hearty co-operation of all of the company's employés. The speaker, in closing, referred to his resignation as managing director, and the appointment of Mr. W. C. Lusk in his place. It was his intention to continue to take an active part in the affairs of the company, but naturally a considerable portion of the work and responsibility which had heretofore been his would now devolve upon Mr. Lusk. He had been connected with the company for a long time as a director, and as manager of their commercial departments, and they could look forward with confidence to his administration of the affairs of the office of managing director. —Earl Buxton seconded the motion, which was carried unanimously.

Guernsey Electric Light and Power Co., Ltd.

The accounts to be submitted to the shareholders to-day (Friday) show that after writing off discount and commission on debentures issued during the year, &c., provision for depreciation, loan interest, and preference share dividend, there remains a balance of £9,103. It is proposed to place £3,500 to general reserve; to pay a dividend of 10 per cent. on the ordinary shares (£5,000); and to carry forward the balance (£603). The accounts show a further improvement. The sale of electricity for lighting shows a considerable increase, but owing to the depression in the stone-quarrying industry power sales have fallen.

Urban Electric Supply Co., Ltd.

The directors' report for 1922 shows an increase in the balance carried to net profit and loss account from £95,563 to £122,007. After deducting £65,672 required for interest, debenture stock redemption, income tax, and the half-yearly dividend on the cumulative preference shares, and adding £5,619 brought forward, there is an available balance of £61,954. It is proposed to dispose of this as follows:—General reserve, £5,000; reserve for depreciation, £30,000; half year's dividend on the cumulative preference shares, £6,250; and one quarter of the arrears of preference dividend, £12,500; leaving a balance of £8,204 to be carried forward. At the meeting on May 16th it is proposed to submit resolutions providing for the cancellation of the balance of arrears of cumulative preference dividend in consideration of the rate of dividend being increased from 5 to 6 per cent. as from January 1st, 1923; for purchasing funded dividend certificates; for subdividing the ordinary and preference shares; and for amending the articles of association.

Since the closing of the accounts, the company's Newton Abbot undertaking has been purchased by the local Council for a sum, fixed by arbitration, of £59,275.

Minehead Electric Supply Co., Ltd.—The energy sold during 1922 amounted to 289,549 kWh, an increase of 9 per cent. over 1921. Large sums were spent on maintenance of mains; the capital outlay on the 600-h.p. suction gas plant and on new mains, &c., has not yet become revenue producing. Profit on trading, £2,170, plus £42 brought forward. Debenture and preference interest, £1,396; to depreciation and reserve, £601; dividend of 6 per cent., less tax, on the ordinary shares; carrying forward £23.

La Plata Electric Tramways Co., Ltd.—The *Financial Times* states that after providing for debenture and other interest the accounts for 1922 show a profit of £9,722, which, added to £7,251 brought forward, and after allocating £10,000 to reserve fund, leaves a credit balance of £6,973 to be carried forward, subject to corporation tax, if any.

Richardsons, Westgarth & Co., Ltd.—Profit for 1922, £329,547. The directors recommend a dividend of 8 per cent. on the ordinary shares, and a bonus of 10 per cent. £45,000 written off for depreciation; £50,000 put aside for further development of internal combustion oil engines; £25,000 to general reserve; £100,000 invested in war stock as a reserve for future preference dividend; £10,000 to staff development fund. £62,583 carried forward.

Siemens Bros. & Co., Ltd.—The directors report a profit of £14,041 for 1922, against £200,994 in 1921. They are unable to recommend payment of the cumulative preference dividend for the last six months of the year, and no dividend can be paid on the ordinary shares.

Dorman, Long & Co., Ltd.—The dividend on the preferred ordinary shares at the rate of 8 per cent. per annum is to be paid for the half-year ended March, 1923, but no interim distribution on the ordinary shares is recommended.

Anglo-American Telegraph Co., Ltd.—The four quarterly dividends, together with income tax amounting to £68,906, absorbed altogether £262,500, being the rent paid by the Western Union Telegraph Co. for the year, equal to 3½ per cent. on the ordinary stock, 6 per cent. on the preferred stock, and 1½ per cent. on the deferred stock. A balance of £65,625 is available for the payment of dividends for the quarter to March 31st, 1923.

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee under Rule 159:—

Andhra Valley Power Supply Co.—£1,000,000 7½ per cent. 10-year secured sterling notes (registered), issued at 98 per cent., partly and fully paid.

Midland Electric Corporation for Power Distribution.—£45,600 5 per cent. first mortgage debenture stock.

Lancashire Electric Light & Power Co., Ltd.—Final dividend of 8 per cent. per annum on the cum. participating preference shares, making 7½ per cent. for the year, also a dividend of 7½ per cent. on the ordinary shares for the year.

Adelaide Electric Supply Co., Ltd.—Interim dividend at the rate of 12 per cent. per annum on the ordinary shares for the half-year.

Vera Cruz Electric Light, Power & Traction Co., Ltd.—Final dividend of 2½ per cent. per annum on the ordinary shares for the half year, making 7½ per cent. for the year; £5,000 has been put to depreciation and general reserve; £2,500 corporation profits tax; £12,443 carried forward.

Chloride Electrical Storage Co., Ltd.—Final dividend of 5 per cent. actual, free of tax, on the ordinary shares, making 10 per cent., free of tax, for year, and a bonus of 5 per cent. actual, free of tax.

Johnson & Phillips, Ltd.—Dividend of 5 per cent. per annum on the ordinary shares, less tax, carrying forward £18,114. Meeting: May 17th.

Callender's Cable & Construction Co., Ltd.—Dividend for 1922 at the rate of 15 per cent. per annum, less tax, on the ordinary shares, carrying forward £226,901. Meeting: May 17th.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets have dropped into a somewhat quiet condition, but the appetite for investment securities is scarcely checked. Speculation is hanging its head, and this causes a good many of the markets to wear a dullish appearance, while amongst the gilt-edged securities, some of the War Loan satellites failed to maintain the top notes which they reached some ten days ago. The shrinkage in the latter, however, has been so slight as to arouse no uneasiness, or more than a passing inquiry as to whether the possibility of money rates becoming stiffer on a trade revival is likely to materialise or not. The various authorities who are speaking and writing on the matter admit that the outlook is difficult to gauge, and their own diversities of opinion are consolatory to the ordinary investor in the street who likes to see his stocks and shares standing at good prices, and to feel that the prospect of their remaining firm warrants his sleeping peacefully o' nights, without a thought of selling at the present levels.

Various electricity supply shares are better. Rises have occurred in Westminsters, St. James's, and Charing Cross. Edmundson's and Urban ordinary are both 2s. 6d. higher. The split shares of the Bournemouth & Poole company have risen to 31s., which is equivalent to 15½ for the £10 shares.

South Londons are also quoted as £1 shares, and stand at 35s. middle, equal to £7 for the undivided shares. Brompton and Kensingtons retain their price at 36s. 6d., at which a few can be obtained, affording a yield, on the basis of the last dividend, of £6 11s. 4d. per cent. on the money. A thousand ordinary shares are on offer in the City of London and in the County companies, the former paying 6¼ per cent. on the money, the latter 5 1/16 per cent. at the present prices of 46s. 3d. and 39s. 6d. respectively. Midland Counties Electric ordinary at 19s. 6d. yield 5¼ per cent. on the money, while the company's newly issued 6 per cent. preference shares, which came out at 20s. and are now 5s. paid, can be bought at 1¼d. premium, giving a yield of £5 19s. per cent. on the money. Partial dividends are payable in September next and in March, 1924, after which the shares, fully-paid, receive the full 6 per cent. Westminster Electrics at 9¾ return about 6¼ per cent. on the money.

Interest is alive as to what the British Electric Traction Co. is likely to pay in respect of the year just ended. The announcement is due this month. The interim dividend of 2 per cent. was distributed five months ago, and the market is looking for a possible 3 per cent., to make 5 per cent. for the year, though some of the optimists think it will be more. For the last completed year the full dividend was 4½ per cent. The 6 per cent. preferred stock retains its rise at 100.

Anglo-Argentine Tramways first preference have gone back to 3 5/16, but the 5 per cent. debenture stock has risen to 82½. No fresh developments are reported from Buenos Aires in regard to the dispute over the question of fare-raising which engages the municipality on the one hand and the company on the other. A substantial rise in Mexican Light & Power first bonds to 75½, *i.e.*, 5 points up, is the feature amongst these issues. President Harding is quoted as having said this week that the question of recognition by the United States of Mexico is imminent. Once more, therefore, the flame of hope is fanned by expectations of Mexico settling down, and its commercial avenues opened up through the instrumentality of some big loan from the United States to Mexico. British Columbia stocks are quiet. Private advices from Vancouver report that the present season is shaping rather better than it had been expected to do, having regard to the difficulties, experienced during the winter, of finding employment for the population of the province.

The feature in the Home Railway market is the manner in which Metropolitans and Districts have both spurted, the former stock putting on 4 points at 73, while Districts rose 1¼ to 56. Underground Electric ordinary shares are ¼ lower at 3½, and the "A" shares declined to 9s., but otherwise the market is steady.

Western Telegraphs at 18¾ have come into line with Eastern Telegraph shares and Eastern Telegraph ordinary stock. The market is a good one, and the recently-aroused apprehension in regard to wireless developments, which had the effect of bringing down cable prices rather sharply, has now passed away completely. Marconis at 2 5/16 continue a dull market. The announcement published this week by the National Association of Radio Manufacturers was read with a good deal of interest, and the chairman's speech through the microphone the other night, when he declared that the B.B.C. will be content with a return of 7½ per cent. on the capital, came as something of a surprise to those who had previously talked of the colossal profits that this company must be making. Great Northern Telegraphs at 30½ are 10s. up. United River Plate Telephones gave way to 7½. Direct United States Cable, after changing hands at 6¾, went back to 6 7/16.

Babcock & Wilcox are quoted ex the 2s. 6d. free of tax dividend, but are still cum rights, and will remain so until after the meeting at which the directors' proposals to increase the capital shall be confirmed. The cable manufacturing shares are strong, with rises in British Insulated, Callenders and Henleys. Of the new issue prices, Andhra Valley Power 7½ per cent. Notes, which came out at 98, stand at 1 discount. North Metropolitan Electric 5½ per cent. debentures, with 15 per cent. paid, command a premium of 2¾; St. Maurice Power debenture stock, issued at 99½, is now 107, and Yorkshire Electric ordinary shares, 5s. paid, stand at 3s. premium, having risen a shilling during the past few days.

Siemens fell abruptly to 17s. on the company's announcement that the profit for the year was £14,000, and that no dividend would be paid on the ordinary shares. Besides this, the 10 per cent. cumulative preference dividend is passed in respect of the six months ended December 31st last. This is disappointing, because people had looked for a small distribution on the ordinary. The preference fell to 25s., and the 4½ per cent. debenture weakened to 87. General Electrics have gone back to 20s. 9d. English Electric preference strengthened to 20s. 6d., and, amongst miscellaneous issues, Whitehall Electric debenture rose to 95. London United Tramway debenture is better at 65½, and a gain of 2 points in Metropolitan Electric Tramways 4½ per cent. debenture lifted the quotation to 75½. The District company has just sold a block of its own 5 per cent. debenture stock at 97½.

The rubber market is weak, in consequence of the price of the commodity having fallen to a shade below 1s. 2d. per lb., on sales by weak speculators who bought stocks earlier in the year, and who are disappointed at the way in which the market has moved against them ever since. Iron, steel and armaments are dull, on a fair amount of profit-taking from the North and West of England.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Nom.	Dividend. 1921.	Dividend. 1922.	Price May 8. 1923.	Rise or fall.	Yield p.c.
Brompton Ordinary	£1	12	12	36/6	—	£6 11 4
Charing Cross Ordinary ...	£5	9	14	10⅞	+ ⅛	6 10 0
do. do. do. 4½ Pref.	£5	4½	4½	4⅞	—	5 6 0
Chelsea	£5	6	10	8½	—	5 17 8
City of London	£1	14	15	2 1/16	—	6 9 10
do. do. 6 % Pref. ...	£1	6	6	23/-	—	5 4 4
County of London	£1	8	10	39/6	—6d.	5 1 3
do. do. 6 % Pref. ...	£1	6	6	1⅛	—	5 4 4
Edmundson's Ordinary	£3	Nil	—	2½	+ ½	Nil
do. 6 % Pref. ...	£5	12/-	—	4⅜	—	6 18 4
Kensington Ordinary	£5	10	12	8⅞	—	6 18 4
London Electric	£3	4	10	4⅞	—	6 3
do. do. 6 % Pref. ...	£5	6	6	5⅛	—	5 17 1
Metropolitan	£1	7	8½	28/6	—	5 19 4
do. 4½ % Pref.	£1	4½	4½	17/-	—	5 6 0
Newcastle-on-Tyne Ordinary ...	£1	Nil	2½	7/8	—	2 17 2
do. 5 % Pref. ...	£1	5	5	15/9	—	6 7 0
do. 7 % Pref. ...	£1	7	7	24/6	+1/-	5 14 2
Notting Hill, 6 per cent. Pref....	£10	6	6	9½	—	6 9 9
North Met. Elec., 6 % Pref. ...	£1	6	6	1 1/16	—	5 13 0
Urban Ordinary	£3	Nil	—	1⅝	+ ⅛	Nil
do. 5 % Pref. ...	£5	2½	—	4⅞	—	5 5 3
St. James' and Pall Mall ...	£5	12	14½	11	+ ¼	6 11 10
South London	£1	7	10	1⅞	—	5 14 3
South Metropolitan Pref. ...	£1	7	7	1 3/16	—	5 14 10
Westminster Ordinary	£5	10	12	9⅜	+ ⅛	6 4 4
Whitehall Elec. Invst., 7½ % Pf.	£1	7½	7½	19/6	—	7 13 10

Home Rails.

Central London Ord. Assented	Stock	4	4	73	—	5 9 7
Metropolitan	,,	2½	3½	73	+4	4 16 0
do. District	,,	1	3	56	+1½	5 7 2
Underground Electric Ordinary	£10	Nil	Nil	3⅜	— ⅛	Nil
do. do. "A" ...	£1	Nil	Nil	9/-	—6d.	Nil
do. do. Income	Stock	4	5	97½	—	*5 2 9

Telegraphs and Telephones.

		Dividend. 1920.	Dividend. 1921.			
Anglo-Am. Tel. Pref.	Stock	6	6	104	—	5 15 5
do. Def.	,,	1½	34/6	22½	+ ¼	6 11 10
Chile Telephone	£5	6	6	6¼	—	4 16 0
Cuba Sub. Ord.	£10	7	7	7½xd	—	9 6 8
Eastern Extension	£10	10	10	18⅞	—	5 6 8
Eastern Tel. Ord....	Stock	10	10	187½	—	5 6 8
Globe Tel. and T. Ord.	£10	10	10	18⅝	—	5 6 0
do. do. Pref.... ...	£10	6	6	11½	—	5 4 4
Great Northern Tel.	£10	24	28	90½	+ ½	7 4 4
Indo-European	£5	10	10	35½xd	—1	4 18 7
Marconi	£1	25	15	2 1/16	— 1/16	6 10 0
Oriental Telephone Ord. ...	£1	12	12	2⅝	+ 1/16	*4 3 6
United R. Plate Tel.	£5	8	8	7½	— ¼	*5 10 4
West India and Panama ...	£10	Nil	Nil	5/-	—	Nil
Western Telegraph	£10	10	10	18⅞	+ ⅛	*5 6 8

Home and Foreign Trams, &c.

Anglo-Arg. Trams. First Pref.	£5	5½	12½	3 5/16	— 1/16	8 6 0
do. do. 2nd Pref.	£5	Nil	5½	3 1/16	—	9 1 6
do. do. 5 % Deb.	Stock	5	5	82½	+1	6 1 5
British Electric Traction Ord.	,,	4½	—	74½	—	6 0 10
do. do. 6 % Pref.	,,	6	6	100	—	6 0 0
Brazil Tractions...	£100	Nil	Nil	52	—1½	7 13 10
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	87½	—	5 15 7
do. do. Preferred	,,	5	93/-	78½	—	*6 0 0
do. do. Deferred	,,	8	124/-	88½	—	*6 19 9
do. do. Deb. ...	,,	4½	4½	80	—	5 6 8
Lond. & Sub. Trac. 5 % Pref.	£1	2½	3½	11/-	—	9 2 0
London United Tram. Deb. ...	Stock	4	4	65½	+1	6 2 2
Mexico Tram. 5 % Bonds ...	—	Nil	Nil	82½	+1	6 2 8
do. 6 % Bonds ...	—	Nil	Nil	61½	+1	Nil
Mexican Light Common ...	£100	Nil	Nil	21½	—	Nil
do. Pref.	£100	Nil	Nil	51½	+1	Nil
do. 1st Bonds ...	—	Nil	5	75½	+5	6 12 5

Manufacturing Companies.

Babcock & Wilcox	£1	15	20	4⅜xd	— 1/16	4 11 4
British Aluminium Ord. ...	£1	10	5	21/9	—	4 12 0
British Insulated Ord.	£1	15	15	2⅝	+ 1/16	6 0 0
Callenders...	£1	15	15	2 7/16	+ 1/16	6 8 0
do. 6½ Pref.	£1	6½	6½	23/-	—	5 18 1
Crompton Ord.	£1	10	5	⅝	—	6 18 4
Edison-Swan	£1	10	Nil	4/8	—	Nil
do. do. 5 % Deb.	Stock	5	5	64	—	7 16 4
Electric Construction	£1	10	10	28/9	—	6 19 2
English Electric	£1	8	5	18/-xd	+9d.	5 11 1
do. do. Pref.	£1	6	6	20/6	+6d.	5 17 1
Gen. Elec. Pref.	£1	6½	6½	23/3	—	5 11 10
do. Ord.	£1	10	5	20/9	—9d.	4 16 5
Henley	£1	15	15	2⅝	+ 1/16	6 0 0
do. 4½ Pref.	£5	4½	4½	4⅞	+ ⅛	5 0 0
India-Rubber	£1	10	—	14/6	—6d.	—
Met.-Vickers Pref.	£2	8	8	2 7/16	+ 1/16	6 4 9
Siemens Ord.	£1	10	10	17/-	—4/6	Nil
Telegraph Con.	£2	20	20	25½	—	*4 16 0

* Dividends paid free of Income Tax.

SWISS PROBLEMS AND PROGRESS.

In commenting on the crisis in the Swiss machine industry, due largely to protective tariffs in purchasing countries and low exchange rates in competing countries, the Commercial Secretary, at Berne, says in his recent report* that the best course for Switzerland to take would appear to be a policy of granting Government loans to countries with a low rate of exchange. This has been done to Roumania, the loan no doubt being made conditional on orders being placed in Switzerland. Reduction in the cost of production is called for and the Government is beginning to realise that the restriction of hours to 48 per week does not accord with present day conditions and is not justifiable. There are two hopeful factors. Electrical manufacturers, who have suffered less than other branches because of the work given them by the railway department, may rely on a fair continuance of orders, as the Government makes a point of placing contracts almost exclusively with Swiss firms. Secondly, German competition seems to be growing less dangerous owing to high cost of production.

During the past year, however, there was a definite decrease in the number of new orders in the electrical industry. In the heavy branches the cost of labour rose 165 per cent. between 1914 and 1920. Now it stands at about 100 per cent. above pre-war level. It is pointed out by the Swiss makers that in the United Kingdom and the United States the increase is only 60 per cent.

In summarising the position, the Commercial Secretary says that for the electro-technical industry, particularly the section engaged in making special electrical appliances, the year 1922 has been one of the worst ever experienced. The situation has improved somewhat of late and prospects are, for the moment, brighter. Raw materials and half-wrought products are of better quality and obtained more easily. The average decrease in the price of raw materials since 1920 is from 35 to 40 per cent. Coal prices have fallen 60 per cent., whilst those of iron and copper have been reduced 50 per cent. The only exception is that of silk, the prices of which have been following an upward trend, whereas rubber is now quoted below pre-war prices. Brass is still much above normal quotations.

High Wages and Short Hours.

The average wage reduction is approximately 10 per cent. since 1921. Certain concerns only suppressed the special allowance for the increased cost of living, while others have even increased the wages of their hands. A further general reduction in wages can only be taken into consideration in the case of a definite decrease in the cost of living. The 48-hour week has also affected the cost of production adversely. In view of the unfavourable conditions prevailing throughout this branch of industry, an increase in the number of working hours is considered inopportune at present.

Many concerns are working at a loss. The home market has been lacking in possibilities, and many foreign markets are completely closed to the Swiss products. It is not surprising therefore that unemployment is very acute in the electrical industry. The general lack of confidence, the tendency of workmen to work less and the unsound state of foreign exchanges are undoubtedly the cause of the present crisis in the industry.

Should, however, the foreign exchange problem be satisfactorily solved, and labour become cheaper and more efficient, the electrical industry cannot fail to re-open its former relations and recover its prosperity of old, notwithstanding all the economic barriers set up by other countries. As most of the Swiss electrical concerns have already a world-wide repute, and as their staffs are well trained and efficient, a certain optimism with regard to future possibilities of development is not misplaced.

The total imports of electrical machinery during the first nine months of 1922 amounted to 349 tons, valued at 287,000 fr., as against 418 tons, valued at 785,000 fr., for the corresponding period of 1921. Her exports were as follows:—

	Francs.
1922—3,575 tons, valued at	18,994,000
1921—5,359 tons, valued at	32,467,000

On account of falling receipts on the Federal railways, it was decided to postpone all expenditure this year for which there was no urgent necessity. Preference was, however, given to electrification, and the sum assigned to electric traction work totalled 47,000,000 fr., only 10,000,000 fr. below last year's allocation. The estimate for rolling stock (22,450,000 fr.) is about 2,000,000 fr. smaller than in 1922; the items include 70 electric locomotives and "automotors" (the latter to be run either by electricity or with benzine), five tractors with accumulators, and dynamos for lighting 40 passenger coaches. No further steam locomotives will be required.

The following comparative table, showing the estimated expenditure for steam and electric traction as well as the kilometres run, illustrates the satisfactory results due to the extension of electric traction and the fall in the price of coal:—

	1921.	1922.	1923.*
Kilometres run—			
Steam locomotives ...	27,554,145	28,500,000	28,000,000
Electrical ,, ...	2,385,562	4,000,000	5,000,000
Total ...	29,939,707	32,500,000	33,000,000
Cost of motive power—			
	Francs.	Francs.	Francs.
Coal	79,200,00	67,400,000	39,900,000
Electricity	2,500,000	4,300,000	8,300,000
Total ...	81,700,000	71,700,000	48,200,000

(* Estimated.)

By the end of next year, the report points out, 21 per cent. of the total length of the Swiss Federal Railway system will have been electrified. The sections already converted are:—

	Km.
Iselle-Brigue	22
Brigue-Sion	53
Berne-Scherzlingen	34
Chiasso-Lucerne (Gotthard Line)	225
Arth-Goldau-Zoug	16
Immensee-Rothkreuz	7
Lucerne-Zurich	55

Electrification work is now proceeding on the following lines:—

Lucerne-Basle (to be ready by January, 1924)	92
Sion-Lausanne (to be ready in the autumn, 1923)	92

The lines Zurich-Ulten-Berne (130 km.) and Thalwil Richterswil (27 km.) will be electrified next, while the projects for the electrification of the Lausanne-Daillens-Vallrobe and the Daillens-Yverdon lines are well in hand. On private lines there have been no new extensions with the exception of the Rhætian Railways (Canton Grisons) which have now completed the electrification of their whole system at a total cost of £48,000 for the 277 kilometres of line.

Hydro-electric Power.

There are now 25 water power stations either completed or in course of erection in Switzerland, furnishing more than 20,000 h.p. each. The following stations have been put into service within the last fifteen months:—

Broc (Canton of Fribourg).—Built by the Entreprises Electriques Fribourgeoises. Equipped for 24,000 h.p., to be extended later to 30,000 h.p.

Lungernsee (Canton of Unterwald).—Central Swiss Power Co. Actually equipped for 18,000 h.p.

Klosters-Kueblis (Canton Grisons).—Belongs to the Grisons Power Co. Furnishes 25,000 h.p., to be extended to 55,000 h.p.

Amsteg (Canton of Uri).—Swiss Federal Railways. Equipped for 68,000 h.p., of which 54,400 h.p. is being utilised at present for traction purposes on the Gotthard and other recently electrified lines.

The following stations are now in course of construction:—

Barberne (Canton Valais).—For the electrification of the first division of the Swiss Federal Railway system. To furnish 7 million kilowatt-hours during the winter 1923-24. To be finally equipped for 68,500 h.p.

Waeggithal (Canton of Schwyz).—Belonging jointly to the North-East Swiss Power Co. and the town of Zurich. Two stations of an aggregate power of 140,000 h.p

Chancy-Pougny (Canton of Geneva).—On the Rhône. Belongs to the Société des Forces Motrices de Chancy-Pougny. To be completed in 1924. 43,000 h.p.

Davos-Klosters (Canton Grisons).—Belongs to the Grisons Power Co. 30,000 h.p. To be completed (first stage only, of 20,000 h.p.) in the autumn, 1924.

Champsec-Bagnes (Canton Valais).—Société d'Energie Electrique du Valais. First stage, 7,000 h.p.

The question of erecting a power station of 80,000 h.p. at Rupperswil (Canton Argovie) and at the Etzel (Canton of Schwyz) is being examined by the Swiss Federal Railways. Concessions have recently been granted to the Central Swiss Power Co. for the erection of a 50,000-h.p. station using the waters of the Seelisbergsee (Canton of Uri), to the St. Gall and Appenzell Power Co. for the utilisation of the Mutten Lake (Canton Glaris), and to a company contemplating the utilisation of the water-power of the Upper Tourtemagne Valley (Canton Valais). Another project for the construction of a 135,000 h.p. power station at Sion, utilising the water of the River Dixence, has just been submitted to the approval of the Valaisian Cantonal Government.

The amount of energy supplied in 1922 by the Swiss power stations was lower than that supplied during 1920 and 1921. It is estimated that the yearly output of energy from Swiss stations amounts to approximately 2,000 million kilowatt-hours. The energy furnished and consumed by isolated stations and the Federal railway power stations totals 700 million kilowatt-hours. The sum total of utilised energy in a year is therefore 2,700 million kilowatt-hours, or approximately 750 kilowatt-hours per inhabitant. The yearly export of energy is estimated at 350 million kilowatt-hours.

* Department of Overseas Trade.

THE "GLO-CLAD" WIRING SYSTEM FOR MINES.

There are three main directions in which a large number of electrical installations in mines might be subjected to criticism The regulation permitting the use of unarmoured cables for pressures lower than 250 volts is often acted upon, whereas it should be disregarded owing to the virtual impossibility of suspending v.i.r. cables efficiently from insulators without contravening one or more of the General Safety Clauses. Secondly, double-pole fuses or similar automatic protection should be provided at every cable reduction. This is not always acted upon. All cables and their accessories should be metallically enclosed. As regards cables, this can be effected either by drawing them into tubing or by armouring.

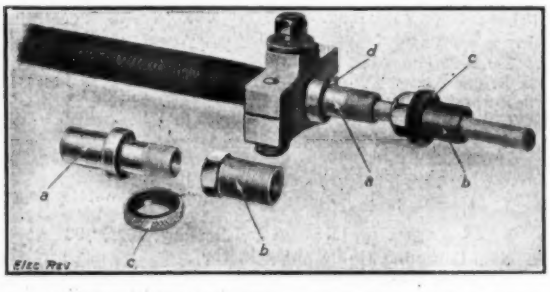


Fig. 1.—"Glo-Clad" Gland and Armour Clamp.

The former is unsatisfactory on account of mechanical abrasion and the condensation of moisture, as well as other risks. With regard to accessories, attempts have been made to comply with the regulations by the use of flame-proof flanges. These flanges, however, to be really efficient, must have a width out of proportion to the fittings of the small size involved.

To meet these three points Messrs. W. T. Glover & Co., Ltd., Trafford Park, Manchester, have produced the "Glo-Clad" wiring system. This fulfils the first requirement by the use of armoured cables throughout. Double-pole switches and fuses are provided on every branch circuit. All lighting fittings, switches and distribution boxes are filled with a plastic and resilient compound, applied in a cold state, which effectually plugs up air spaces, making the accumulation of explosive mixtures impossible. The fuse cubicles are so constructed that the blowing of a fuse cannot ignite methane even if it is present in the most explosive quantity. The system is very complete, commencing from a main fuse and distribution board to the ultimate fittings.

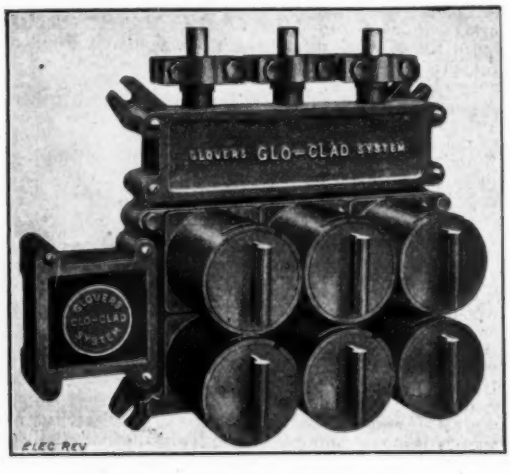


Fig. 2.—Fuse Distribution Board.

The s.w.a. cables are made in three types, all having conductors insulated with pure and vulcanised rubber: (i) a lead-alloy sheathed or "Glo-Clad" cable. This is covered with a seamless watertight sheath of an alloy harder than lead, but possessing adequate ductility; (ii) a bitumen sheathed cable; and (iii) a fibre-padded type which, while not possessing the water-resisting capacity of the other two cables, is quite suitable for ordinary mining conditions. These cables are all of the same overall diameter, there being two conductor sizes; twin 3/.036 in. and 3-core 3/.029 in. The lead-alloy sheathed cable and the other two types naturally require different glands.

The gland for the first cable is illustrated in fig. 1. It will be seen that it consists of three parts. Part (*a*) fits over the metal sheath and under the wires and serving, being screwed at the front end upon a thread cut in the metal sheath. Part (*b*) screws over (*a*) and into the joint box, being held to the latter by a lock nut (*c*). The annular portion of (*a*) is filled with a packing, as is also the lock nut. The illustration also shows the type of armour clamp which is employed. This is of malleable iron and provided with a lug and set screw for bonding purposes. For cables having no screwed lead sheath a stuffing-gland fitting is used. This is rendered water-tight by means of a graphited bitumen washer fitted between the male and female portions of the gland. Fig. 2 shows the fuse distribution board used with the system. As will be seen, it is of very substantial construction. The fuses are double pole on all distributing circuits, each fuse being contained in a separate cubicle. The construction of the latter is shown in fig. 3. The essential feature of this arrangement is that the cubicle cannot be opened until the fuse has been put out of circuit, or, in other words, the fuse can only be disconnected or blown when the cover is in an absolutely flame-tight position. An extraordinary length of fuse wire is allowed for, and ample surfaces are provided for choking down the expanding gases resulting from the arc caused by the blowing of the fuse. At Sheffield University one of these fuse units was wired with a 10-amp. fuse and placed in a gas chamber in which was placed an explosive mixture of firedamp and air, a sample showing 8.9 per cent. methane. A current of 40 amp. was passed through the fuse, and it was reported that no flame passed from the apparatus to the explosive mixture, nor was any damage caused to the apparatus.

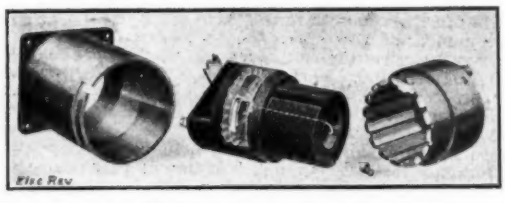


Fig. 3.—Component Parts of Fuse Cubicle.

The standard lighting fitting, with well glass, is illustrated in fig. 4A. This consists of an octagonal box in which is placed a base of fire-resisting insulating composition in two parts. The main part is an insulating diaphragm which separates wires of opposite polarity or phase by means of channels on its under side, which are used in the cases of boxes provided with three or four ways. The smaller portion is a connecting block of similar material, provided with a third terminal, which may be used for looping or for a switch wire, as required. The diaphragm is firmly screwed to the carcase of the box and the connector is screwed to the diaphragm, as shown in fig. 4B. To ensure that the fitting is made flame-tight, without the use of flanges, a block of resilient and plastic compound is cemented to the box lid. When the lid is screwed down this compound is squeezed into the box, entirely filling up all interstices, as shown in fig. 4C. As an

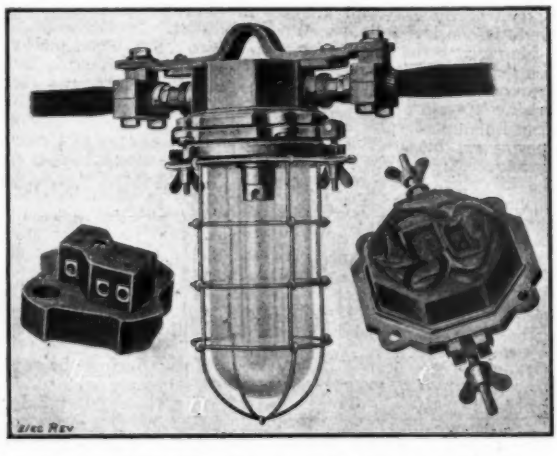


Fig. 4.—A. Assembled Lighting Fitting; B. Base and Connector; C. Compound Plug after Pressing.

additional security the box is fitted with a tongue-and-groove joint, which is luted with graphited bitumen. The lighting fitting, which can be supplied in one-, two-, three-, or four-way patterns, carries a lamp-holder riveted to its lid, and the well glass is firmly held by means of an iron ring and wing nuts to a rubber gasket, which is cemented to the lid. A strong galvanised-steel or cast-iron guard is supplied.

The double-pole switch required by the regulations is designed on similar lines to the lighting fitting. The carcase is strongly constructed of cast-iron, fitted with the standard glands, and contains the same hollow circumferential groove filled with graphited bitumen, common to the lamp and similar fittings, into which the V-shaped lid is pressed. A resilient compound plug is also used. An extremely small cavity is necessary for the internal movements of the switch. Any

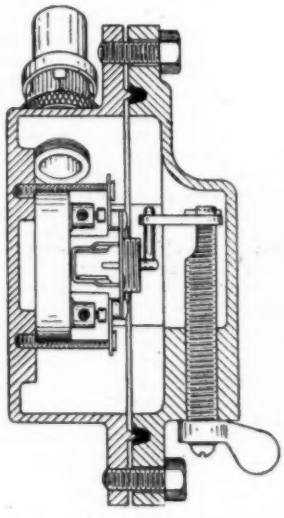


Fig. 5.—Sectional Drawing of Switch.

explosive mixture of gas and air which might possibly find access thereto is rendered harmless by the threaded surface of the specially long screw which throws the switch into the "on" and "off" positions by means of jaws attached to its inner end. Fig. 5 is a sectional side elevation of the switch.

In addition to these components the system also includes, when desired, flood lighting fittings, and also a special die and holder for threading the ends of lead-sheathed cables.

From this brief description it will be seen that a system has been evolved which will satisfy in a simple way the strict requirements of the Home Office regarding the use of electricity in mines.

A NEW HOUSE SERVICE METER.

The E.A.C. Type "E" Meter.

The new a.c. meter about to be described is the result of an endeavour on the part of the Electrical Apparatus Co., Ltd., to produce an induction meter that will withstand critical examination. That every detail has been carefully considered is shown by the fact that even the name-plate has the figures engraved upon it—a much neater job than the usual stamping. The type E possesses several noteworthy characteristics, is well made and neat in appearance; its size is small without being cramped, its weight only 4.5 lb., weight of rotor, 18 grammes, torque, 4 gramme centimetres, speed 40 r.p.m., shunt loss 1.1 watt, and series loss 0.55 watt at full load.

The meter has a large open dial, and the gear can be supplied in either the clock (pointer) or cyclometer (flying figure) form, with a testing disk, fig. 1; the readings are direct in kWh, without the use of a constant, and, with a view to making the meter suitable for use in every sort of climate, all the working parts are of non-rusting materials.

The two brass fixing screws are held in position by the friction of leather washers under the head, so that they cannot fall out in transit; the leather washers form a damp- and dust-proof joint when the fixing screws are screwed home through the back of the meter case. The terminals are neatly arranged, and knurled screws take the place of the usual testing links, which are generally somewhat awkward to remove and replace. The cover consists of a substantial steel pressing, and the cord is carefully made with a concentric joint, and beds down on to the case in a satisfactory manner all round, including where the joint occurs. The complete meter can be removed from its case, fig. 2, by unscrewing the two small screws. The back box is a substantial stamping, and the corners are neatly pressed over and reinforced underneath to take the fixing screws; a felt packing ring ensures a dustproof joint.

The dial is registered by the bearing screw at the top and two slots in the projecting arms. There is no play at all, and the dial must take up its correct position. The spindle carries a pinion and not a worm, the latter following the first gear wheel, thereby reducing the effective friction of the worm. The magnets do not have to be disturbed in order to remove the rotor, and the top bearing screw carries the pintle. The jewel is fixed in the centre of gravity of the rotor, and, being inverted, cannot accumulate dirt and dust in the course of service. It is very easily removed with an ordinary screwdriver, and renewal is a very simple matter. The pivot is spring-supported and carried in the bottom bearing screw. Its renewal is as simple and easy as that of the jewel—a great advantage.

Two holes in the disk are an additional safeguard to prevent creeping, and large air gaps are provided. The adjustments are equally accessible when the meter is assembled. It should be noted that both top and bottom bearing screws are screwed right home, and no adjustment is provided for. All adjustments are on the micrometer principle,

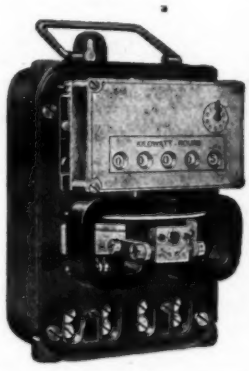


Fig. 1.—Type E Meter with Front Cover Removed.

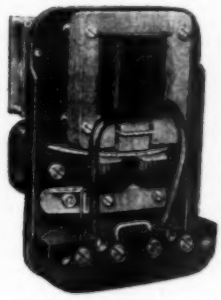


Fig. 2.—Back View with Cover Removed.

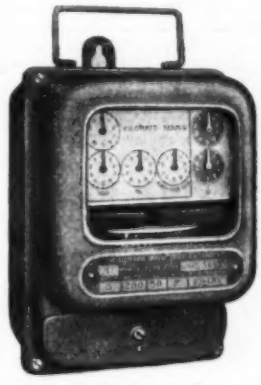


Fig. 3.—Exterior View of the Meter.

and do not require locking after the correct position has been obtained. The meter is made to run faster or slower by turning a screw within the magnet gap. This adjustment is sometimes referred to as the top-load adjustment, but, as a matter of fact, it affects the whole of the curve by an equal percentage. For the low-load adjustment the series system can be moved in either direction by turning another screw. The power factor loop is raised or lowered by turning a third screw. Only one screwdriver is required to fix the meter, to take it to pieces, and to make all adjustments.

A new element has been introduced into the problem of meter design by the many changes in voltage and frequency which are a necessary concomitant of the activities of the Electricity Commissioners in connection with the general tendency towards the co-ordination of existing undertakings and distributing networks. The Type "E" meter is specially suitable wherever substantial changes in voltage or frequency are possible at some future time. Meters can be supplied for, say, 200 volts, which will register both inductive and non-inductive load on any voltage between 100 and 300 without any readjustment whatever, so that one meter could be used successfully on a 300- and on a 100-volt circuit. Its accuracy on low loads on a greatly reduced voltage would not be quite so good as that of a meter designed for the voltage at which it is to be used, but registration would be within "Board of Trade" limits. Similarly, the meters can be adjusted by the simple method of turning a screw to read non-inductive loads accurately on any of the usual frequencies—and no adjustment at all is needed unless the variation in frequency is more than 33⅓ per cent. With inductive loads an additional adjustment, very easily added, is needed for such a large variation of frequency, and this can be provided with the meter if the requirement is known at the time of manufacture. The accuracy curve of the new meter is practically flat from below 1/20 load to 100 per cent. overload.

Fig. 3 is an exterior view of the meter.

Oils for Transformers and Switchgear.—The British Engineering Standards Association has published a tentative specification (No. 148, 1922, price 1s. net) for insulating oils for use in transformers, oil switches, and circuit breakers. This is the first B.E.S.A. specification based upon the work of the British Electrical and Allied Industries Research Association, and research in this connection is still in progress. The Institution of Petroleum Technologists is also preparing methods of testing oils for the ordinary physical properties—viscosity, flash point, &c.—which it is hoped will be available for use in connection with the specification.

ELECTROMAGNETIC FORCES.*

A Proposed Revision of the Laws.

By CARL HERING, Fellow A.I.E.E.

The fundamental laws of electromagnetic forces and motions formulated some 50 or 100 years ago may have served their purpose perfectly for a time, and some are still very serviceable if limited to special cases, but in the rapid development of the various applications of electricity more and more weight has been rested on these original laws and they are now being held responsible for applying equally correctly to new and much more severe conditions than were even thought of by those who framed them. The writer's experience with the application of electromagnetic forces in practice has convinced him that the time has come when they should be re-examined and tested, to find whether they can still safely stand the weight of the much greater responsibilities which we are now placing on them, or which may in the future be placed on them. As these forces are the basis of all motive devices using electrical energy, it is of the utmost importance to the engineer to be able to place absolute reliance on them.

The purpose of the present paper is to show by means of experiments and arguments how certain of our older laws and explanations of electromagnetic forces and motions, as now taught in many text books and colleges, sometimes mislead or lead away from, rather than toward the truth, how they sometimes fail to apply, even specifying results directly contrary to the facts, and how they have practically forbidden us to enter new fields in which progress might perhaps be made; also to offer interpretations of these experiments and to suggest how the laws might be revised to bring them up to date.

By passing currents, especially at high current densities, through such very mobile metallic conductors as mercury or molten metals in some types of electric furnaces, the writer many years ago noticed the existence of some heretofore unrecognised electromagnetic forces which tended to move the conductors, and being mobile liquids they responded much more readily to such forces than solid conductors do.

Some of these new forces were very formidable, for like most of such forces they presumably increase with the square of the current. The writer then made use of them in electric furnaces, many of which are in daily use, these new forces being the absolutely essential factor, showing their industrial importance.

Not only were there these new forces, but that gospel faith in the reliability of laws which the engineer ought to be able to have, led the writer in two notable cases to waste time and money before finding out that the laws had not been correctly stated. These experiences gave rise to the present investigation, which developed similar results with other laws.

The elementary law given in every text book, that like currents attract and unlike repel, is wrongly worded; it is not on the currents but on the material of the conductor that these forces act. If they acted on the currents then the current density would have to be greater in the centre of a conductor than near the outside, and Ohm's law would no longer apply to large conductors; or when two conductors were close to each other the current densities in different halves of the same conductor would have to be different; or the current in the middle of a cathode or anode in an electrolytic bath would have to be greater than elsewhere. But we know these are not the facts. Moreover, like cathode rays repel. The industrially important pinch effect† would not exist, yet we know it does. Maxwell (Art. 501) recognised and called attention to this important distinction between the current and the conductor, but many of his followers did not. Nor did Maxwell continue to make a similar distinction in his law of induction (Art. 531) as he ought to have done.

In a paper before this Institute (*Trans.*, Vol 27, Part T, 1908, p. 1341) the writer described a simple experiment showing conclusively that a similar distinction must also be made in Maxwell's law of induction. It is the conductor, that is, the matter and not merely the circuit, which must cut the magnetic flux in order to induce a current; if the circuit alone cuts it, the conductor remaining stationary with respect to the flux, there will not be the slightest induction even though exactly the same linkages of the flux and the circuit have taken place. This important law, therefore, also requires revision. It, moreover, also fails to show in what part of the circuit the induction actually takes place and therefore what parts are dead or inactive, which it is sometimes of importance to know.

The writer maintains that just as in the two cases mentioned above it is necessary to make a similar distinction between the conductor itself and the magnetic field surrounding it. The forces in this field have their seat and origin in the material of the conductor where the electrons are passing through it; this should therefore be their anchorage or abutment; any actions of these forces on each other or on a foreign force should, therefore, have their reaction in the conductor. In other words the flux around a conductor or magnet should be pictured as though it were in some way elastically attached to the material in which its source lies. Faraday entertained this idea (*Exp. Res.*, Vol. 2; p. 293; Vol. 3, p. 447) as pointed out by Maxwell (Art. 529) when the latter says: "He even speaks of lines of force belonging to a body as in some sense part of itself, so that in its action on distant bodies it cannot be said to act where it is not." Maxwell, however, does not favour the idea of action at a distance (Art. 552).

One of the most common of the older laws concerning the production of motions by a circuit is to the effect that a circuit will produce such motions as will make it include more flux. This law, though often true, is not based on the correct fundamental principle, the increase in flux so often noticed being an incidental and indefinite secondary consequence which may or may not take place, and is not the true primary cause, and therefore not the proper crucial factor in a law. In the most usual case of a motor the flux does not increase but remains constant, hence the law fails even in the most usual case. But more than that, in the simplest and most fundamental case, which is described below, the flux is actually *less* in amount after the motion.

Another favourite law is that only such motions will take place as will increase the self inductance. This is a badly defined law as it involves a factor which is entirely foreign to the case, the number of turns in a coil; the magnetic forces are entirely independent of this factor, at least for direct currents; they depend on the ampere-turns. The self inductance is a purely geometric quantity and is independent of any current or energy. In every motor, and in certain electric furnaces in which powerful motion exists, the self inductance remains constant.

Another law is to the effect that anything that increases the stored energy will give rise to a force. There is no such increase in a running motor; and in the most fundamental case described below the stored energy becomes *less* (as it should) when the force acts.

Another is that such motions will take place as will increase the permeance. This also fails for motors unless rescued by forced definitions of sliding contacts. With such ambiguities and inaccuracies of the older laws, a new law seems very desirable. Above all, a law should not forbid what may be possible.

In view of these discrepancies, and the fact that when forces act to produce motion it involves energy, the writer concluded to look for a general, universal law among those for energy.

There is a well-recognised general law in physics applied generally to a system of mechanical forces and energy, to the effect that *in any system such motions will tend to take place as will reduce the potential energy of the system*; this potential energy is thereby transformed into the kinetic energy of the motion; water flowing from an elevated storage reservoir is a simple example.

It is believed that this is a universal law of nature, and therefore should apply in quite as general a way to any and all electromagnetic systems in which potential energies are involved and mechanical motions are produced. To make it more convenient to be applied directly to electromagnetic systems, it seems preferable to re-draft it and state it in such electrical terms that it will not only be correct and easily understood but that it cannot be misunderstood, nor will it deny what may be possible. What the best wording is, is a matter of opinion.

The writer suggests the following version for the usual conditions: *In an electromagnetic system in which the current is being maintained by a source, any and only such mechanical motions of the conductor will tend to take place as will generate a counter e.m.f. somewhere in the circuit.* The actual motions which this tendency will produce will depend, of course, on the particular freedom of motion which the various parts of the circuit may have. The counter e.m.f. is not necessarily generated in the part that moves, as will be shown below. It is believed that this is a universal law of all such electromagnetic systems, that is, that there are no exceptions.

The reason for introducing the clause about the current and the source is to exclude certain very unusual cases, like

* Abstracted from the *Journal* of the American Institute of Electrical Engineers.

† Considering a conductor as consisting of a bundle of filamentary ones, this force tends to make them move to the centre. When the conductor is a liquid, the material is free to move and these radial forces may then become great enough to cause rupture. This phenomenon has been called the pinch effect.

condenser discharges, and others in which there is (as with permanent magnets) no outside source of supply of additional energy when some is withdrawn from the system; to also include such unusual cases the statement of the law would seem to have to suffer in simplicity. The universality of the law is, of course, claimed only for the cases specified in it, which, however, are the usual ones.

Magnetic material such as iron in such a system can store and give off some energy and thereby may introduce a correction factor in some cases. General laws are supposed to be exactly correct only under theoretically perfect conditions, and just as the element of friction does not invalidate the general laws of mechanics, so the presence of iron should not be considered as invalidating this law.

The Counter E.M.F.

In a system consisting of current-carrying conductors the potential energy in an electromagnetic system resides in the magnetic flux energy which is stored when the current is started. When such flux energy produces mechanical motion, that is, kinetic energy, it disappears as such.

When the potential energy of the flux is transformed into the kinetic energy of mechanical motion it seems evident that no counter e.m.f. should be produced directly thereby, though there will be when this lost energy is subsequently replaced again by the current. This is shown by the following example of a more fundamental case.

Assume two parallel copper rings at 0 deg. absolute temperature at which their resistance is zero; let like and equal currents be started in both by drawing a magnet pole through them; the energy of this process will then be stored as magnetic energy and the currents which maintain it would then continue to flow indefinitely. Now let the rings move toward each other by their attraction over a certain distance and then stop, thereby converting part of their potential energy into kinetic; there will then be less magnetic energy and therefore less current flowing after the motion has ceased. This cannot be due to a counter e.m.f., as the motion has ceased.

If two unlike poles of two permanent magnets are permitted to move toward each other an amount of the flux energy must have disappeared exactly equal in amount to the kinetic energy produced by this motion. This is restored again when the two poles are subsequently forced apart. In both of these cases the flux itself, as distinguished from the flux energy, will also be found to be less. These two illustrations were chosen because there is no source of new energy connected to them to replace that which was transformed to mechanical energy. The immediate, practically simultaneous, replacing of this lost flux energy by the usual source is therefore hereby shown to be a secondary consequence, and not the primary cause of the motion, and it is this supply of new energy which really generates the counter e.m.f., just as in the starting or increase of a current. This seems to be an explanation of the reasons why a counter e.m.f is always generated when such a system generates mechanical motions.

One of the objections to using the term " potential energy " in the above electrical equivalent of the general physical law is that it may not always be clearly and definitely understood. But a greater objection is that it may sometimes involve necessary and perhaps complicated explanations of apparent contradictions and ambiguities. A careful and unbiased analysis will, however, show that these contradictions and anomalies are only apparent and not real.

To the writer it seems that the generation of a counter e.m.f. is the best crucial condition in the electrical equivalent of that general physical law, to take the place of the reduction of the potential energy. That they are the equivalents of each other, or at least necessary accompaniments of each other, when there is a source, seems evident; the general physical law calls for such motions as will reduce the potential energy, the flux energy in the electrical case. This flux energy then must disappear as such when it is transformed into the kinetic energy of motion; as the current necessarily always generates as much flux as the reluctance of the surrounding space permits, it will at once replace any flux which has thus disappeared and, as is well known, the generation of any flux in a circuit is always accompanied by a counter e.m.f. The writer has applied this simple law to every case he could think of, old and new, and it never fails to apply correctly. If no exceptions can be found to it then it seems to be a universal law for the class of phenomena specified in it.

If this law is sustained a number of deductions follow. It specifies no limitations to any particular directions of the forces which produce the motions, hence any directions are possible, provided only that the motion generates a counter e.m.f. somewhere in the circuit. It has been strenuously maintained that these forces could be only perpendicular to the conductor and never otherwise; it therefore opens up a formerly forbidden field. If, for instance, any particular motion is desired, it follows from this law that if that motion is such as would produce a counter e.m.f., then it ought to be possible to make the system produce it by providing the necessary freedom of motion. This has, for instance, been made good use of for giving molten metals a desired motion in some types of electrical furnaces.

Lengthening a current-carrying conductor (the stretch effect), reducing its cross section (the pinch effect) straightening it (the corner effect), winding it into a coil, &c., all produce a counter e.m.f. in a constant-current circuit and the circuit could therefore (theoretically at least) be made to produce them. According to Lenz's law, reversing any of these motions should generate current.

(To be continued.)

HIGH-SPEED ALTERNATORS.

Discussion at Birmingham.

Mr. J. Rosen's paper on the above subject (which was abstracted in our issue of February 23rd, 1923) was read at the South Midland Centre of the Institution of Electrical Engineers, on April 25th, and in the subsequent discussion Major A. M. Taylor suggested that if the Institution (or the I.M.E.A.) could issue a questionnaire to all the electricity stations in the kingdom, as had been issuel by the National Electric Light Association in the U.S.A. (some of the results of which Major Taylor gave in table form), it would be of immense value. The average " outage " for large American sets (30,000 to 45,000 kW) was 17.9 per cent., which was very different from the 5 per cent. of Mr. Rosen's curve. To emphasise the importance of getting absolutely rid of tooth ripples in the wave form at all loads, he mentioned a case he had recently examined, of a generating station feeding through trunk mains at 6,000 volts to a point, say, a couple of miles away, there being parallel with this transmission line a step-up 30,000-volt transmission line. The neutral points of the generator system and of the high-pressure star of the step-up transformer were earthed. The star winding of the transformer might give an oscillograph curve perfectly free from triple harmonics, but if the generator had an extremely small third harmonic it might pass current in series through the earth connection of the high-pressure star of the transformer, and then through the capacity of the 30,000-volt mains to earth at the distant point, and might return through the capacity of the 6,000-volt mains to the generator busbars and so through the alternator windings back again to earth. He had found that there was danger of a capacity current, which might be only of the order of one ampere, so affecting the excitation of the step-up transformer as to start a third harmonic in it and (neglecting for the moment the wiping-out effect of the delta on the primary side of the transformer) which would produce a 10 per cent. third harmonic that would act through the capacity of the line and tend to produce sufficient current to give a 30 per cent. third harmonic. Hence a cumulative deformation of the transformer wave would be produced, and in order to be sure of being free from this, there must be nothing bigger than a 3 per cent. third harmonic or a 1 per cent. ninth harmonic in the generator. This was not a case of resonance proper, but merely depended upon the deformation of the e.m.f. wave of the transformer.

Mr. A. T. Bartlett queried the method of measuring the deformation of rotor caps adopted by the author. It seemed impossible that the rotor, sparking point, and camera should all remain relatively in the same position; vibration and windage would cause movement comparable with the quantity being measured. Even with fixed points the spark method of measuring small gaps had proved unreliable. He had found traces of permanent deformation in rotor caps, notwithstanding the fact that the caps had been stressed considerably below the limit of proportionality. There seemed to be no doubt that, if the stress did not exceed the fatigue load, no permanent deformation could occur. The most satisfactory form of rotor was the solid steel forging. The effect on the exciter current of any sudden change in the stator current was not sufficiently recognised.

Mr. J. Morton thought that the author was an advocate of higher speeds, which, from the designer's point of view, was perhaps permissible; were he, however, engaged on the supply side, he would perhaps alter his views as to reliable maximum speeds.

With regard to the closed system of ventilation, the volume of air for the third 15,000-kW set for the Nechells station had been fixed at 0.1 cu. ft. per kW. However, the machine was designed for a power factor of 66.6 per cent. instead of the usual 80 per cent.; consequently, the allowance was considerably less than that put forward by the author. Reversal of polarity of exciters due to overload or short circuit, the author had got over by the addition of a few turns of compounding, but where a battery was installed and properly maintained and was used for excitation, a separately-excited auxiliary shunt winding would take up less space and also enable the machine to build up much quicker.

Mr. T. R. Alexander suggested that the magnitude of the eddy currents induced in the modern rotor, and the arcing at the spigot of the rotor caps, pointed to the neces-

sity for careful examination at the annual overhaul. The usual insulation under the exciter bearing pedestal to ensure an open circuit for these currents seemed open to criticism. In several sets pitting had been observed on the turbine governor gun-metal worm wheel, which was driven by the steel worm on the turbine shaft; pitting was also found on the white metal at the ends of the rotor coupling bearing. The rotor eddy currents were thought to be responsible for these defects, but the fact that pitting only seemed to occur between different metals might suggest some other cause. After fitting a good earthing brush on the alternator rotor shaft near the coupling the trouble was practically overcome, but not absolutely.

Mr. H. JOSEPH presumed that the author's firm was satisfied that mica flakes held together with varnish did form the best possible slot insulation. Tests made on Empire cloth and an insulating material built up of mica flakes varnished on to thin paper, both materials being of the same thickness, revealed a much higher puncture test with the former than the latter, the mica showing very variable puncture voltages. He regarded linen and cotton tapes, not as insulators, but as a mechanical medium for holding a film of varnish.

ELECTRICITY IN IRON AND STEEL WORKS.

Some Economic Principles.

By C. A. ABLETT, M.Inst.C.E.

(*Abstract of paper read before the* IRON & STEEL INSTITUTE.)

THE paper is principally concerned with the selection of power plant and the source of power is considered under separate headings:

Power produced by the works themselves from natural resources available within the works.—(*a*) High load factor is considered a natural resource of steel or iron works, as its effect is to cheapen the cost of power produced by reducing the capital charge, which forms part of the total cost per unit of power (kilowatt-hour) produced, just in the same way as the utilisation of a natural heat resource reduces the fuel charge, which also enters into the total cost per unit (kilowatt-hour) of power produced. The load factor of an iron or steel works can easily be between 60 and 70 per cent. (in some cases even higher) and means can often be devised for improving it. The average load factor of the municipal electricity undertakings of five of the largest industrial cities in Great Britain was, over a recent period of twelve months, 21.48 per cent. Thus an iron or steel works produces about three times as many units of power from its plant as a public supply authority would, and consequently the capital charge per unit of power produced would, in the case of an iron or steel works, be about one-third that in the case of a public supply authority.

For a steam-turbine plant with gas-fired boilers the total cost of power is 0.2d. per kWh at a 65 per cent. load factor and 0.57d. per kWh at a 21.5 per cent. load factor. For a steam turbine plant with coal-fired boilers the corresponding figures are 0.42d. and 0.86d., so that high load factor has a greater effect in cheapening the cost per unit than saving the coal bill by using a waste heat resource; correspondingly, the advantage of high load factor together with the utilisation of a natural heat resource is an ideal condition. Corresponding figures for a low-speed gas-engine plant are 0.29d. and 0.82d., but it frequently happens that there is insufficient gas to produce the whole of the power by steam-turbine plant with gas-fired boilers; in such a case the plant might consist of a combination of gas—and coal—fired boilers, in which case the total cost of power produced by steam-turbine plant at a 65 per cent. load factor can easily exceed the cost of that produced by gas-engine plant, but the gas engine is clearly not economical except at high load factors, but this only becomes apparent when the overall economy, including capital charges, &c., is compiled.

The above comparisons relate to a central electric power-producing plant. If the plant includes either gas-driven blowing engines or steam turbo-blowers, the above chain of reasoning applied to the combinations will show a marked increase in economy in favour of the gas-driven combination, as the gas-driven blowers will appear in a very favourable light as compared with the steam turbo-blowers.

In general, the more economical the power plant is in fuel consumption, the great the capital cost of the plant becomes. If the cost of production with steam-turbine plant and coal-fired boilers at 21.5 per cent. load factor be compared with the cost of production with gas-engine plant at a 65 per cent. load factor, the steam plant capital charge per unit is 0.36, while the more expensive but more economical low-speed gas-engine plant shows a capital charge per unit of 0.19. By capital charge is meant the interest on the capital expended, the annual allowance for depreciation of plant, and the annual allowance for obsolescence of plant; combined depreciation and obsolescence taken over whole works averages about 5 per cent. per annum; but if this combined figure be applied to individual items of plant in order to arrive at the cost of production incorrect conclusions can easily be arrived at, and it is therefore preferable in dealing with individual items of plant to assess the depreciation and the obsolescence separately.

(*b*) Blast-furnace or coke-oven gas is more economical for heating furnaces than as a source of power, and therefore the gases should be used for heating to the fullest possible extent, and only the residue, after all heating requirements have been fulfilled, should be used for the production of power.

One must endeavour to determine in what direction technical improvements may be expected which are likely to render existing plant obsolete, and consideration must be given to the possibility of power-producing plant which will prove less wasteful in heat than those which are available to-day. If means become available to enable the products of combustion to be exhausted at or about atmospheric temperature, thus materially increasing the temperature range in which the gas-engine works, the gas-engine plant would utilise considerably more than 30 per cent. of the heat supplied to it. Boilers have been connected to gas-engine exhausts with the object of achieving this result, but it is not impossible that a materially better solution of this problem may become available. Steam-turbine plant working at abnormally high pressures has been introduced to enable it to utilise more than 15 per cent. of the heat supplied to it. By adopting abnormal pressures a saving of the order of 15 per cent. on the coal bill becomes possible. Such a saving at a 65 per cent. load factor would reduce the cost per unit from 0.42 to 0.39, effecting a saving of 7.1 per cent. in the cost of power; at 21.5 per cent. load factor the possible saving would be 5.8 per cent. in the cost of power. In adopting abnormally high pressures great care is necessary that the extra capital cost involved does not give rise to increased capital charges per unit produced, which will completely overshadow the saving in the coal bill.

(*c*) Hot burnt gases from steel furnaces, puddling furnaces, &c., do not contain any combustible material and can only be used, as far as power production is concerned, to raise steam under boilers. Where this is being done economically sufficient power can be produced to drive the rolling-mills and other plant in an *ironworks* without recourse to any other source of supply, except in cases where considerable quantities of steel are being rolled in the mills in addition to iron.

But the quantity of steam which can be raised in this way is very strictly limited and can only supply a portion of the power requirements of a *steelworks*.

Power produced by the works themselves from exhaust steam.—An exhaust steam turbine is usually installed in conjunction with a steam engine which already is obsolescent; thus directly it is installed it automatically becomes obsolete to a similar degree to the steam engine. If, therefore, after the capital cost of the exhaust steam plant is so arranged that it would be written off in a comparatively short period, the total costs of the plant appear favourable, then a favourable case has been made out for exhaust steam. Such a scheme may appear very attractive and enable the available power in the works to be increased at an apparently low capital cost for a few years; but when future extensions demand additional power an exhaust steam plant may prove a serious stumbling block, as it would become a question either of obtaining additional power at the expense of high operating costs, or of sacrificing the capital expended on the exhaust steam plant before the redemption period is completed. Exhaust steam is an asset of a more than doubtful character, and the exhaust steam turbine unfortunately has been pushed into many places which lie outside its economic field of application.

Utilisation of power for driving rolling mills.—Electrically-driven mills rolling the same type of section under generally similar conditions show great variations in the quantity of power consumed per ton rolled, and consequently there exist marked differences in the working costs of such mills where one might expect that they would be approximately the same. Such differences have been too readily accepted by engineers, and insufficient attempts have been made to ascertain the cause.

The electrical drive gives ample facilities for detecting and remedying cases of high-power costs arising from high-power consumption due to roll drafting, but little has been done in

this direction. To obtain the best all-round result, i.e., the lowest combined capital and power costs, complete balance-sheets must be prepared to represent the different conditions under which the mill has to work, after consideration of the manner in which the rolling programme may develop in the future.

If the power consumption of a mill is high at full output the percentage increase as the output decreases may easily become very great, so that such a mill may become very wasteful indeed when rolling small outputs. This suggests an economic problem worthy of the most careful consideration. The engineering side of an iron or steel works should be treated in the same manner as the commercial side, in that it should be the subject of a series of regularly prepared balance sheets, which should be subjected to scrutiny at stated intervals.

MERSEY AND WEST LANCASHIRE ELECTRICITY DISTRICT.

Liverpool City Council last week adopted the following resolution:

"That, in view of the altered conditions, especially the secession of several authorities, the sub-division of the Mersey and West Lancashire Electricity District by the formation of the Wirral Electricity Joint Board, and the alteration of the scheme originally proposed for the re-organisation of the supply of electricity in the district, the Liverpool Corporation are not prepared to support the draft Mersey and West Lancashire Electricity District Order, 1923, issued by the Electricity Commissioners, and desire to withdraw from that scheme."

The chairman of the Mersey Docks and Harbour Board wrote that the committee's decision was a reversal of the Council's policy, for which it had asked and obtained the support of the Dock Board. Experience had shown that increased economy and efficiency for a commercial and industrial district were brought about by unified control over electrical supply. They had only to look at the benefits which such a system had bestowed upon Tyneside and the large surrounding district in the North-East of England to realise what Merseyside had so far missed. The Mersey and West Lancashire Electricity District Provisional Committee, the Mayor of Bootle, and the Warrington Corporation Electricity Committee also wrote expressing the hope that the decision would be reconsidered.

The Electricity Commissioners asked the City Council to defer action on the resolution until the position had been discussed by representatives of the Corporation and the Commission, and stated that they would be pleased to receive a deputation in London on Monday, May 14th.

The Chairman of the Electricity Committee, Mr. T. White, told the Council that it was apparently not realised what an emasculated scheme was being left for Liverpool. They were asked by people who had sold their undertaking to Liverpool, and by an authority which had not a penny-piece at stake, to agree to something which was quite impossible. The Liverpool undertaking represented a value of about £6,000,000, and Liverpool, which was to contribute over 60 per cent. of the load and over 50 per cent. of the plant, was to be represented by 6 out of 25 members of the joint body. He was not able to say what was to be the ultimate benefit to the city by way of a better or a cheaper supply. There was no comparison between Merseyside and the North-East Coast, with its great works and shipyards, and the figures which had been quoted were worthless. The only sensible thing to do was to withdraw from the No. 2 scheme.

The Liverpool Chamber of Commerce wrote to the Lord Mayor expressing the hope that, while safeguarding any Liverpool municipal interests endangered, the City Council would not withdraw entirely, nor take steps to wreck a scheme which contained so much that was vital to the development of industries in the district. It was decided to call the attention of the Birkenhead and Wallasey authorities to the great importance to the future of the whole district of combining in one authority.

Birkenhead Town Council, which met the same day as the Liverpool City Council, on hearing the Liverpool decision, decided to ask the Commissioners to allow Birkenhead to conduct its future electrical development independently of other authorities, or, failing that, to join with Wallasey in the setting-up of a joint board for the Wirral district.

Reserving the right of action if any fundamental change is proposed in the scheme for the formation of a Wirral Joint Electricity Board, the Wallasey Council has approved of the draft Order of the Electricity Commissioners.

The local inquiry which the Electricity Commissioners are about to hold at Liverpool has been deferred to Thursday, May 17th, instead of May 15th, as previously arranged.

RESEARCH LABORATORIES AT SHEFFIELD UNIVERSITY.

Through the generosity of two leading citizens of Sheffield, the Applied Science Department of the University in that city has now become possessed of two very fine research laboratories, which were formally opened by Sir Oliver Lodge, on May 3rd. The donors were the late Mr. Joseph Jonas, a former chairman of the Applied Science Department, who during his lifetime gave £5,000, and the late Mr. W. Edgar Allen, who left a legacy of a like amount. The Jonas Research Laboratory is for the mechanical testing of materials, and the Edgar Allen Research Laboratory for investigations concerning magnetism, the magnetic properties of materials, and allied subjects.

The Jonas Research Laboratory is equipped with testing machines for tension and compression, fatigue (one designed by Prof. B. P. Haigh, in which alternating tensile and compressive stresses are applied by electromagnetic means), torsional stress, &c., slip in metals (a method devised in the laboratory by Mr. C. Handford, employing a thermionic valve), and a variety of instruments.

The Edgar Allen Research Laboratory is provided with two-phase and d.c. supplies, experimental wiring, a motor-generator and transformer, accumulators, a very powerful electromagnet, and numerous electrical and magnetic measuring instruments.

In Mr. Handford's device a flat tensile test piece, having one surface polished, is placed in a Denison testing machine; on a portion of the polished surface is laid a slip of mica, and on this again a flat plate of brass, held in position by a light ebonite clamp. The system constitutes a small condenser, and by placing it in connection with a thermionic valve, oscillating with a certain frequency, minute changes in the capacity of the condenser may be measured. This is done by placing near the machine a second oscillating valve tuned to give beats of 100 per second with the first. A note of audible frequency is thus produced, which is amplified by means of a two-valve amplifier and passes to a telephone. When a specimen is placed under tension no change in the system occurs until crystalline slip begins; the polished surface then becomes minutely ruffled, the distance between the two plates of the condenser being thus increased. The change in capacity produced in this way alters the beat note, and it is, therefore, possible to determine the load at which crystalline slip begins. The relation of this load to the elastic and fatigue limits is under investigation in the laboratory.

At the opening ceremony, the chair was occupied by Sir William Clegg (chairman of the Applied Science Department), who was supported by Sir Henry Hadow (vice-chancellor of the University), Drs. Ripper and Desch (of the Applied Science Department), many members of the University Senate and representatives of well-known firms in the city.

The chairman pointed out that the Applied Science Department was opened in 1885, and had grown to very large proportions. The department had met with considerable support, financial and otherwise, from all the local manufacturers, and the city itself, through the Corporation, was a large contributor to its funds. The day students now numbered 340, and the evening students 1,213. The department had an annual expenditure of about £36,000. The number of individual students who had passed through the institution since its commencement had been 15,350, a very satisfactory number of whom had obtained various degrees, diplomas, and associateships. When the institution was started there were no laboratories of any kind at any of the large works of Sheffield. Now, there was no large works which had not its laboratories. In some of those works it was a condition that the persons engaged in the laboratories should go to that department to perfect their education, and inducements were placed in the way of those students who went there for the purpose of self-improvement, and also for the advancement of the interests of their employers. The city had raised £100,000 to build, equip, and maintain the department. The late Mr. Joseph Jonas was responsible for the collection of £50,000 of that sum.

Sir Oliver Lodge, in the course of a long and interesting speech, remarked that discoveries of extraordinary interest were being made in metallurgy. They used to be taught that when a girder went to pieces through age and vibration it was because it began to crystallise. He believed that idea was now exploded. Crystals had been discovered in metal which were nearly as big as one's hand, and the way that these behaved when subjected to stress was most instructive, and most important from the engineering point of view. By analysing metal by means of X-rays, a Cambridge mathematician, Mr. Taylor, assisted by Miss Elam, had dissected the behaviour of Prof. Carpenter's single-crystal test pieces, and had communicated to the Royal Society, a few weeks ago, a vitally important and extremely able paper.

He congratulated Dr. Wall on having had the opportunity, which he had long desired, to fit up an electrical research laboratory. Prof. Ripper had entrusted him with the furnishing of the Edgar Allen laboratory, and they could not have had a better man.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

"Arora" Electric Cooking Apparatus.

The equipment illustrated in fig. 1 has been produced by THE ARORA CO., Rosebery Street, Loughborough, to provide a complete kitchen outfit at a moderate cost. As will be seen, it consists of a sheet-metal table upon which are mounted a small oven and two boiling plates, any one of which may be obtained separately. The table has a weight of 40 lb., and is 2 ft. 6 in. high, 3 ft. 6 in. long, and 1 ft. 6 in. wide. It has a shelf for utensils 9 in. from the ground, and is finished in matt black. The oven has double walls of sheet iron, air lagged, having a bright black finish. Elements are fixed in the top and bottom, and three "heats" are arranged. At

FIG. 1.—"ARORA" COOKING EQUIPMENT.

"high" both elements are on circuit, consuming about 1,800 W; at "medium" the 750-W bottom element is used; and at "low" the two elements are in series consuming 450 W. The internal connections of the oven between the walls are made of ½ in. by ⅛ in. w.i. strap insulated from the frame. The elements are easily replaced. The internal dimensions of the oven are: height 16 in., width 12½ in., and depth 12 in. It can be mounted on 6-in. or 15-in. feet. The boiling rings measure 15¾ in. by 10 in., and are 7 in. in height. They weigh 14½ lb. each, and are fitted with a 1-kW element in two portions. There are two openings in the plate of different sizes, beneath which the two parts of the element are fixed.

The "Sterling" Single Receiver.

The telephone receiver illustrated in fig. 2 has been produced by the STERLING TELEPHONE & ELECTRIC CO., LTD., 210-212, Tottenham Court Road, W.1. It provides a convenient

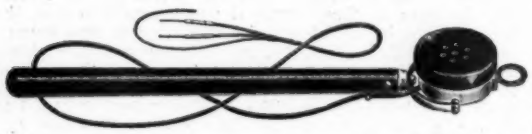


FIG. 2.—THE "STERLING" SINGLE HAND RECEIVER.

means of reception, and consists of a high-grade earpiece with aluminium case mounted with a swivel and trunnion movement on a handle of polished ebonised hardwood.

A Portable Kinema Studio Projector.

Fig. 3 illustrates a portable 24-in. kinema studio projector, designed by the LONDON ELECTRIC FIRM, Brighton Road, Croydon, for concentrated, diffused, and wide-angle lighting. The lantern is mounted on an extensible tripod stand having large castor wheels. Swivelling and tilting movements are provided, and a convenient door is fitted to the operating side of the lantern, together with an observation window. An alternative method is to fit the projector on a short base and mount it on the platform of an extension ladder or tower. The lamp is of the "non-disengaging" feed pattern, which works quite automatically, but at the same time can be hand-fed if required, the feed wheels being brought outside the lantern, providing easy and quick operation. The positive carbon rotates automatically as long as the lamp is burning, and thus preserves a perfect crater formation. For concentrated light effects, a silvered glass mirror is fitted to the rear of the lantern, and the front may be furnished with a plain glass. For softening down, a diffuser is provided. The illuminated area may be increased or curtailed by adjusting the position of the lamp in relation to the mirror, and a simple focusing gear is fitted to facilitate this.

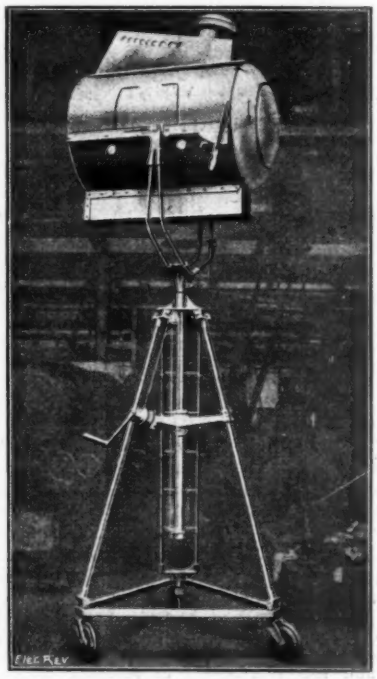


FIG. 3.—PORTABLE KINEMA STUDIO PROJECTOR.

There is also a special provision for obtaining a clear and unobscured wide-angle flood light. It will be seen that the projector has a second aperture (above the front and main aperture), and the mirror is arranged to tilt so that the light may be projected through the smaller opening, converging towards this from the mirror, and thereafter diverging to a considerable (and variable) angle, thus giving a large, uniformly-illuminated field. A diffuser can also be fitted to soften the effect in this case if wanted. Either or both of the front openings can be furnished with "iris" shutters or other controlling device, as may be required. A further point to note is that the frame holding the mirror is made removable, so that the light direct from the arc may be used.

A Traffic-Signal Glove.

The *Daily News* states that Mr. R. BARTON ADAMSON, of Enfield Highway, Middlesex, has invented a gauntlet for use by motorists and traffic controllers. On the back of this gauntlet are mounted two small electric lamps—white and red. The red light is used to indicate stopping or turning, while the white one can be used as an inspection lamp. The battery is contained in a small pocket on the outside of the gauntlet. On the inside of the thumb and two fingers are small metal contact points, and the lamps are illuminated by closing the fingers.

Large Auto-Transformers.

Six of the largest single-phase auto-transformers ever built have just been completed for the Southern California Edison Co., by the Westinghouse Electric and Manufacturing Co. They are of the water-cooled type and are for outdoor service in the Eagle Rock sub-station of the company, to form part of a 220,000-V power system. Each unit is rated at 36,700 kVA, 50 cycles, and is adapted for star-star connection with solidly grounded neutral, stepping down from 220,000 to 150,000 V. A tertiary winding, connected in delta, is supplied for suppressing third harmonics in the voltage wave. The transformers are of the shell type and are designed to withstand without injury mechanical stresses due to short-circuits when unlimited power is supplied at the terminals. The tested efficiency was over 99 per cent.

The Eagle Rock sub-station is designed for 150,000-V incoming transmission lines, and to avoid making changes in the

sub-station, the new auto-transformers will be used to step down the 220,000 volts to 150,000. They are to be connected as an integral part of the 220,000-V line, there being no circuit breakers in the high-voltage side. All the switching and metering will be done as before on the 150,000 side of the sub-station.

One of the auto-transformers is illustrated in fig. 4. Each tank, which has flat sides and half-round ends, is

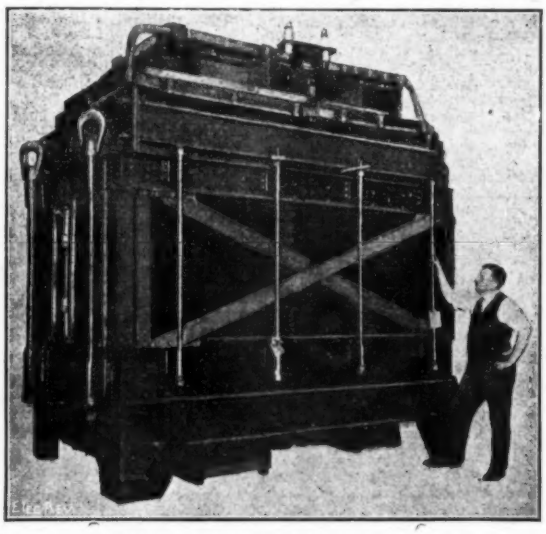


Fig. 4.—A 36,700-kVA, 220,000/150,000-V Auto-Transformer.

10 ft. 3 in. wide, 14 ft. 3 in. long, and approximately 15 ft. high. The height from the ground to the tip of the high-voltage bushings is 27 ft.

About 10,000 ib. of copper and 45,000 lb. of iron laminations were required for each transformer. Over one-quarter mile of copper tubing was used for the cooling coils, and at normal rating 75 gallons of water per minute must be circulated through them. The total weight of the complete transformer is over 90 tons.—*Power.*

PARLIAMENTARY NOTES.

[By Our Special Parliamentary Reporter.]

Radio-Broadcasting.—Sir W. Joynson-Hicks, the Postmaster-General, informed Mr. Tubbs that experimental licences were issued to those applicants who satisfied the Post Office that the object of obtaining the licence was to conduct experiments in radio telegraphy and that they were qualified to do so. Applications for experimental licences from officers and other ranks in the Royal Air Corps of Signals, Territorial Army, who desired to carry out experiments in connection with their Army duties, were given preferential consideration.

Radio Research at Fiji.—On May 3rd, Sir W. Joynson-Hicks informed Sir Burton Chadwick that a small expedition of radio experts had left England under the direction of the Pacific Cable Board to undertake radio research work on Vancouver Island and at Fiji.

Coal Consumption.—On May 1st, Mr. Hardie asked what was the lowest consumption of coal used in the production of electrical energy in the United Kingdom.

Colonel W. Ashley said the returns for the year ending March 31st, 1923, were not yet complete. For the previous year the lowest consumption of coal per kWh generated at public supply stations in Great Britain was 1.7 lb.

Trade with Russia.—On May 1st, Lieut.-Colonel Buckley informed Sir W. de Frece that the imports into the United Kingdom, consigned from Russia, registered during the six months ended March 31st, 1923, were valued at £5,886,000. The exports of United Kingdom produce and manufactures during the same period consigned to Russia were valued at £1,570,000, and the re-exports of foreign and colonial merchandise to £575,000.

Private Bills.—The Oakham Gas and Electricity Bill, and the London County Council (General Powers) Bill have been read a third time in the House of Lords.

London Electric Railway Bill.—This Bill, which authorises the carrying out of extensions of the London Electric Railway, came before the Committee of the House of Commons, which dealt with the City & South London Railway Bill, on May 2nd.

The company proposes to extend its line from Charing Cross to Kennington, *via* Waterloo, to connect the Hampstead and Highgate line with that of the City & South London Railway Co. This extension is also to be connected with the Bakerloo line.

Mr. E. Shortt, K.C., who appeared for the company, said that the average numbers of passengers dealt with at Waterloo and the Elephant and Castle were about 12 and 14 millions respectively per annum. By this scheme the facilities for handling this heavy traffic would be more than doubled. Three new stations would be built, a large booking hall would be constructed beneath Piccadilly Circus, and the Leicester Square station would be enlarged. The total cost was estimated at £2,227,000. The only real opposition came from the Southern Railway Co., which had in hand a scheme to build an underground line from Waterloo to Nine Elms. This company complained that the scheme of the present Bill would cut right across the proposed line and also that the construction of a railway under Charing Cross Hotel would be calculated to damage the property. Lord Ashfield gave evidence in support of the scheme and showed the necessity for this means of dealing with the heavy traffic at Waterloo, which would be increased by the electrification projected by the Southern Railway Co. After hearing the evidence of other witnesses, the Chairman of the Committee (Sir Park Goff) suggested that agreement between the Southern Railway Co. and the London Electric Railway Co. could be arrived at by a consultation of their representatives, but after an adjournment of two hours it was announced that no settlement had been effected. Arbitration was suggested, but the Chairman said that the Committee would deal with the matter and the proceedings were adjourned until May 8th to give the parties time for discussion and, if possible, agreement.

On May 8th, Mr. Shortt stated that the consultation between the two parties had resulted in the London Electric Railways Company's agreeing to withdraw the part of the scheme to which the Southern Railway Co. objected. An alternative scheme would be drawn up and included in a new Bill. The Committee therefore declared the preamble of the Bill passed subject to the insertion of clauses embodying the agreement.

Workmen's Compensation.—During the debate on the Labour Party's Bill to amend the Workmen's Compensation Act, Mr. Bridgeman, the Home Secretary, said the Government intended to introduce a Bill of its own, and hoped to have it printed before Whitsuntide, for debate on it immediately afterwards.

Mr. Ellis, the Labour member for Wakefield, said that where industries were capable of being split up into sections, in so far as different classes of work were concerned, it would be a good thing if some kind of mutual indemnity insurance could be formed, as was done in the coal industry. It might be applicable, and he hoped it would be, to an industry which had grown up in the last two or three years—the electrical industry.

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Patent Agents, 285, High Holborn, London, W.C.1.

10,168. "Star coils for receiving wireless telephony, &c." T. E. Beaumont. April 14th.
10,170. "Electric terminals, &c." J. L. Taylor. April 14th.
10,178. "Inductance coils for wireless telegraphy." G. F. Woods and R. S. Woods. April 14th.
10,182. "Electrically-heated cooking utensils." H. Bohle. April 14th.
10,190. "Electrically-controlled governor." R. M. Balston and T. H. J. Watts. April 14th.
10,196. "Electric transformers." M.L. Magneto Syndicate, Ltd., and D. K. Morris. April 14th.
10,208. "Wireless receiving apparatus." A. MacLennan. April 14th.
10,222. "Homopolar electric current generators or motors." J. N. Chaviara and J. F. Gill. April 14th.
10,226. "Thermostats." P. Grant (Zimmerman). April 14th.
10,903. "Variable grid leaks." F. H. Blaxley. April 23rd.
10,918. "Means for controlling liquid level in electrolytic cells, &c." A. E. Knowles. April 23rd.
10,924. "Electric storage batteries, &c." W. Fisher. April 23rd.
10,934. "Electric fan." A. Meulemans. April 23rd.
10,939. "Electric switches." H. Hubble. April 23rd.
10,947. "Telephone receivers." C. J. Coleman. April 23rd.
10,948. "Loud speakers for wireless apparatus." C. J. Coleman. April 23rd.
10,949. "Loud speakers for wireless apparatus." C. J. Coleman. April 23rd.
10,963. "Electric radiators." G. S. Cattell and G. H. Ide. April 23rd.
10,969. "Signalling systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). April 23rd.
10,979. "Sparking plugs." A. E. Heath. April 23rd.
10,981. "Telephone repeating systems." M. Latour. April 23rd. (France, April 22nd, 1922.)
10,987. "Combined electric switch and plug connectors." General Electric Co., Ltd., and F. Read. April 23rd.
10,994. "Electric cables." N. J. Austin and F. H. Broomfield. April 23rd.
11,026. "Variable grid leaks." H. A. Gaydon. April 23rd.
11,043. "Valve protector for circuits employing thermionic valves, &c." H. H. Chapman, Robins, Chapman & Co., and E. T. Robins. April 24th.
11,050. "Insulator for wireless aerials." A. Parsons. April 24th.
11,066. "Variable resistance for wireless telephony." J. A. Shortt. April 24th.

11,065. "Electric apparatus for generating ozone." J. McBlain. April 24th.
11,066. "Time-setting device for controlling maintenance of an electric circuit for a variable period." E. J. Angel, E. L. Angel, and W. A. Jarvis. April 24th.
11,083. "Adjusting devices for wireless instruments." L. R. Gleason. April 24th.
11,091. "Telephone systems." Western Electric Co., Ltd. April 24th. (United States, December 22nd, 1922.)
11,093. "Electric batteries." D. Pepper. April 24th.
11,097. "Wireless receiving devices." C. F. Elwell, Ltd., and K. Wilson. April 24th.
11,112. "Circuit-controlling devices." E. C. R. Marks (Schweitzer and Conrad, Inc.). April 24th.
11,117. "Electric primary batteries, &c." G. A. Morley. April 24th.
11,123. "Receivers for wireless telephony, &c." L. H. G. Twine. April 24th.
11,125. "Vibrating converters." British Thomson-Houston Co., Ltd. April 24th. (United States, August 24th, 1922.)
11,127. "Portable electric lamp fittings." C. E. Fellowes. April 24th.
11,130. "Flame arc lamp." E. Mommsen. (Legal representative of T. L. Carbone.) April 24th. (Germany, April 24th, 1922.)
11,135. "Telephone receiving instruments." J. E. G. Powell. April 24th.
11,137. "Electric trip switch devices." P. H. Waller. April 24th.
11,140. "Rheostat." F. A. Rojas. April 24th.
11,190. "Crystal detector." A. Preen. April 25th.
11,200. "Condenser for wireless receiving sets." A. Preen. April 25th.
11,204. "Coil-holders for wireless, &c., instruments." A. Rogers. April 25th.
11,207. "Electric lamps." Edison Swan Electric Co., Ltd., and P. Freedman. April 25th.
11,208. "Thermionic devices." Edison Swan Electric Co., Ltd., P. Freedman, and E. Greetham. April 25th.
11,210. "Aerials for wireless installations." P. Richardson. April 25th.
11,216. "Thermo-electric pyrometers." Cambridge & Paul Instrument Co., Ltd., and H. A. Daynes. April 25th.
11,218. "Electric condensers." W. Dubilier. April 25th. (United States, October 25th, 1922.)
11,236. "Fluid-flow meters, &c." British Thomson-Houston Co., Ltd. (General Electric Co.). April 25th.
11,238. "Electro-dynamic transmission systems." Sperry Development Co. April 25th. (United States, May 5th, 1922.)
11,244. "Electric discharge tubes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. April 25th. (Holland, October 21st, 1922.)
11,251. "Headlights of motor vehicles." M. J. Williams. April 25th.
11,252. "Electric heating plates." A. Nielsen. April 25th.
11,285. "Supply of power to wireless transmitters." K. E. Edgeworth. April 26th.
11,292. "Detectors for wireless instruments, &c." Gramostyles, Ltd., and H. Jenkinson. April 26th.
11,294. "Transformation of electrical energy." M. L. Magneto Syndicate, Ltd., and E. A. Watson. April 26th.
11,299. "Electric winches, &c." W. H. Scott. April 26th.
11,300. "Crystal holders for wireless receivers." W. J. Day and A. L. Pattenden. April 26th.
11,309. "Electrical contacts." R. W. M. Thomson. April 26th.
11,331. "Apparatus for taking direct-current voltage free from higher harmonics from a rectifier." Akt. Ges. Brown, Boveri et Cie. April 26th. (Germany, April 26th, 1922.)
11,332. "Process for automatic connection, &c., of installation equipped with mercury-vapour rectifiers." Akt. Ges. Brown, Boveri et Cie. April 26th. (Germany, May 26th, 1922.)
11,347. "Safety switch devices for motor vehicles." A. Marr and E. Smith. April 27th.
11,354. "Telephone receivers." D. McLennan. April 27th.
11,370. "Crystal holder for wireless systems." B. R. Simmons. April 27th.
11,397. "Postal franking machines." Sterling Telephone and Electric Co., Ltd. April 27th.
11,401. "Electro-galvanic soles for footwear." T. A. Gillam. April 27th.
11,403. "Publicity telegraphs." H. K. Harris. April 27th.
11,404. "Telephone register." N. Dawson. April 27th.
11,408. "Electric vacuum tube devices." E. Y. Robinson. April 27th.
11,409. "Carrying case for electric lamps." J. C. N. Eastick. April 27th.
11,410. "Electric knife switch." J. C. N. Eastick. April 27th.
11,411. "Switches and adjustment devices." Igranic Electric Co., Ltd. April 27th.
11,422. "Portable electric safety lamps." R. Ziegenberg. April 27th.
11,425. "Automatic, &c., telephone systems." B. B. Johnson and Relay Automatic Telephone Co., Ltd. April 27th.
11,426. "Regulating devices for electrical apparatus." Aktiebolaget Birka Regulator. April 27th. (Sweden, September 1st, 1922.)
11,428. "Wireless telegraphy, &c." T. B. Sharp. April 27th.
11,439. "High-voltage connection device." Scintilla. April 27th. (Germany, June 16th, 1922.)
11,440. "Cabinets, &c., with aerial systems for wireless reception." E. A. Graham and W. J. Rickets. April 27th.
11,442. "Galvanic cells." R. Ziegenberg. April 27th.
11,443. "Manufacture of incandescent lamps, &c." British Thomson-Houston Co., Ltd. April 27th. (United States, June 14th, 1922.)
11,448. "Plugs, &c., for electric batteries, &c." H. A. Gaydon. April 27th.
11,456. "Telephone systems." Siemens & Halske Akt. Ges. April 27th. (Germany, May 15th, 1922.)
11,461. "Telephone receivers." A. C. Brown. April 28th.
11,462. "Hertzian wave detector." H. A. Burton, D.A.S.H. Wireless Service, and A. H. Onions. April 28th.
11,463. "Means for packing, &c., electric lamps, &c." J. Maginn. April 28th.
11,490. "Electric illuminating means." W. & T. Avery, Ltd., and G. H. Jackson. April 28th.
11,494. "Windings or commutating poles of dynamos." M. L. Kahn and A. H. Railing. April 28th.
11,495. "Miners' electric hand lamps." A. E. Angold, A. H. Railing, and J. Stanley. April 28th.
11,497. "High-tension electric switches." E. Crewdson. April 28th.
11,513. "Sound-emitting, &c., instruments." British Thomson-Houston Co., and A. P. Young. April 28th.
11,514. "Magneto electric machines." British Thomson-Houston Co., Ltd., F. A. Fossey, and A. P. Young. April 28th.
11,515. "Holders for thermionic valves, lamps, &c." J. A. Coomes and J. A. Coomes & Co., Ltd. April 28th.
11,518. "Electric switches." Ferguson, Pailin, Ltd., S. Ferguson, and G. Pailin. April 28th.
11,521. "Controlling circuits of thermionic valves, &c." R. H. N. Dawson and F. K. Woodroffe. April 28th.
11,522. "Tuning devices for radio-telephony, &c." R. H. N. Dawson and F. K. Woodroffe. April 28th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1921.

30,107. "Fastening and coupling dynamo-electric machines to internal-combustion engines." S. L. Bailey. November 11th, 1921. (196,010.)
33,129. "Machine-switching telephone exchange systems." Coventry Automatic Telephones, Ltd. (F. R. McBerty). December 9th, 1921. (196,018.)
33,247. "Method of and means for measuring, indicating, or recording the efficiency of an electric generating station or the component parts thereof." P. C. Gilson and Dubilier Condenser Co. (1921), Ltd. December 10th, 1921. (Cognate application 7,115/22.) (196,019.)

1922.

703. "Joints for underground extra-high-tension cables." A. M. Taylor. January 10th, 1922. (196,037.)
704. "Contact maker for ignition circuits of motor-car and other internal-combustion engines." L. Bussereau. January 10th, 1922. (196,042.)
824. "Motor-car headlights and like lamps." H. Wade (G. A. Garth.) January 10th, 1922. (196,047.)
826. "Construction of direct-current dynamo-electric machines." F. Newton and Newton Bros. (Derby), Ltd. January 10th, 1922. (196,048.)
916. "Apparatus for controlling and regulating electric currents." A. W. Sharman. January 11th, 1922. (196,055.)
1,026. "High-frequency signalling systems." British Thomson-Houston Co., Ltd. (General Electric Co.). January 12th, 1922. (196,062.)
1,065. "Control of alternating-current electric motors." W. Andrews-Tester and S. Thompson. January 12th, 1922. (196,068.)
1,067. "Wireless telephone transmitters." Ges. für Drahtlose Telegraphie. November 2nd, 1921. (Addition to 161,521.) (174,076.)
1,152. "Construction of electric imitation candles." F. G. Parks, Junr. January 13th, 1922. (196,071.)
1,190. "Electric warp stop-motions for looms." C. Bourgeois. January 13th, 1922. (Addition to 174,335.) (196,076.)
1,212. "Electrical transformers." British Electric Transformer Co., Ltd., J. Rootham, and A. J. Huber. January 13th, 1922. (196,079.)
1,215. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. February 23rd, 1921. (175,961.)
1,381. "Combined electric lampholder and switch for the lamps of motor and other vehicles." A. H. Hunt. January 16th, 1922. (196,087.)
1,461. "Electrical switchgear." W. A. Coates and Metropolitan-Vickers Electrical Co., Ltd. January 17th, 1922. (196,094.)
1,584. "Submarine sound apparatus, particularly receiving apparatus." H. Baron (Signal Ges.). January 18th, 1922. (196,100.)
1,599. "Automatic maximum and minimum-current circuit breakers." V. Martinetto. March 15th, 1921. (177,143.)
1,988. "Electric gasfilled glow discharge devices for amplifying electric current variations and similar purposes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. February 9th, 1921. (175,258.)
2,077. "Bonding boxes and the like for electric conductors." Walsall Hardware Manufacturing Co., Ltd., and A. E. Read. January 24th, 1922. (196,107.)
2,266. "Magneto electric lamps." A. H. Railing and A. E. Angold. January 25th, 1922. (196,111.)
2,855. "Electrical resistances for use as generator field regulators or for other purposes." H. C. Hodges. January 31st, 1922. (196,121.)
3,103. "Telephone systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). February 2nd, 1922. (Addition to 170,286.) (196,123.)
3,452. "Construction of electric storage batteries." H. G. Wagner. February 6th, 1922. (196,126.)
3,453. "Positive and negative elements for electric storage batteries and process of making same." H. G. Wagner. February 6th, 1922. (196,127.)
4,542. "Method of electrically welding high-speed steel to tool shanks or foundations of iron or steel." E. Schröder. February 16th, 1922. (196,137.)
5,070. "Electric incandescent lamps." British Thomson-Houston Co., Ltd. (General Electric Co.). February 21st, 1922. (196,141.)
5,925. "Thermostatic electric circuit controllers." British Thomson-Houston Co., Ltd. (General Electric Co.). February 28th, 1922. (196,147.)
6,380. "Electromagnets." British Thomson-Houston Co., Ltd. (General Electric Co.). March 3rd, 1922. (196,152.)
6,651. "Electric switches." A. L. Davis. March 7th, 1922. (196,156.)
8,943. "Telephone systems." Siemens & Halske Akt. Ges. April 7th, 1921. (178,099.)
12,404. "Inductance coil holders for wireless telegraphy or other purposes." A. W. Knight. May 3rd, 1922. (196,188.)
12,503. "Electric measuring instruments." British Thomson-Houston Co., Ltd. (General Electric Co.). May 3rd, 1922. (196,189.)
12,584. "Windmills and wind-driven electric generators." J. H. Garty. May 4th, 1922. (196,190.)
13,169. "Electric cables." Callender's Cable and Construction Co., Ltd., S. E. R. Beecroft, and A. H. Horsfield. May 10th, 1922. (196,192.)
14,064. "Electric insulators." A. M. Willis and Brecknell, Munro and Rogers, Ltd. May 18th, 1922. (196,199.)
14,520. "Metal-vapour rectifiers." Akt. Ges. Brown, Boveri et Cie. June 11th, 1921. (181,695.)
17,758. "Electric contact breakers." R. Bosch Akt. Ges. February 11th, 1922. (192,997.)
23,767. "Telephone head-sets." C. Brandes, Inc. May 12th, 1922. (196,225.)
24,589. "Electrically-operated vehicles." Metropolitan-Vickers Electrical Co., Ltd. September 23rd, 1921. (186,327.)
26,004. "Thermionic generators." Ges. für Drahtlose Telegraphie. November 14th, 1921. (189,035.)
28,351. "Electric discharge lamps." General Electric Co., Ltd. October 19th, 1921. (187,613.)
29,119. "Hollow bodies in which electric-current conductors are hermetically introduced through a glass wall." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. July 28th, 1922. (196,231.)
32,374. "Electric motor-control systems." Metropolitan-Vickers Electrical Co., Ltd. November 29th, 1921. (189,777.)
33,926. "Reception of wireless signals." A. L. A. Petty. December 12th, 1922. (196,233.)

Inventions that are Needed.—The Rt. Hon. Sir William Bull, Bart, M.P., has presented the Institute of Patentees with a book entitled "What's Wanted," and has opened the book by entering what, in his opinion, are the inventions which are needed at the present time. The organising secretary will be pleased to receive, on behalf of the Council, any suggestions which our readers may care to put forward for record in the book; his address is 44, Great Russell Street, W.C.1.